User Guide

Case/room controller (TXV)

AK-CC25 Pro and AK-CC25 Pro BT

SW Ver. 1.2x

For refrigeration appliances and cold storage rooms

Contents

Introduction

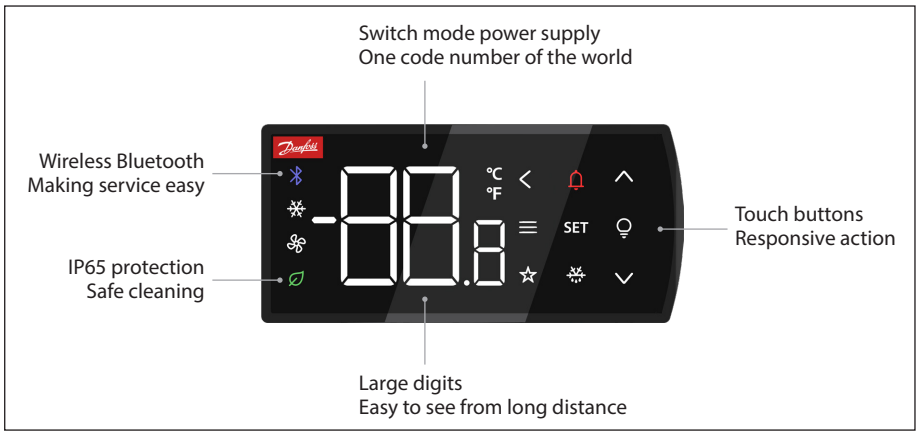
Application

The main applications for the AK-CC25 Pro controller are refrigerated cabinets and cold rooms with integrated compressor and condenser. The controller can also be used for remote cabinets controlling a liquid line solenoid valve instead of a compressor.

Hardware features

The AK-CC25 controller is a compact front panel mount controller with new innovative features like

- Backlit display with capacitive touch buttons
- Built-in Bluetooth (variant specific) for easy commissioning and service via "AK-CC Connect APP" running on mobile device
- Built-in Modbus RS-485 communication for easy integration in network solutions
- Switch Mode Power Supply for wide voltage supply range
- Multi-purpose input and output signals for easy adaptation to a wide range of applications

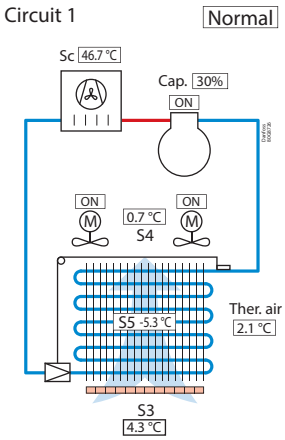


Features and functions

- An intuitive display operation with large digits, icons for status read-out and 10 buttons for easy start/stop of direct actions and navigation in menu structure.
- Broad application coverage as AK-CC25 Pro supports multiple compressor applications like: Single compressor, variable speed compressor, dual circuit cabinets with individual compressor per circuit and single circuit cabinets with dual compressor.
- Quick and easy selection of 8 predefined applications or alternatively a fully flexible programming of all controller in- and outputs.
- Easy start-up via a quick set-up of the main application settings.
- Easy configuration and service using a mobile app with Bluetooth.
- Safety monitoring of high condenser temperature and compressor safety chain with option for lock out of compressor operation at repeated safety stops.
- Dynamic switch between two individual controller setups supporting specific controller configurations for MT and LT operation, respectively.

Principle

The temperature in the appliance is registered by one or two temperature sensors located in the air flow before the evaporator (S3) or after the evaporator (S4) respectively. A setting for thermostat, alarm thermostat and display reading determines the influence the two sensor values should have for each individual function.



The temperature of the evaporator is registered with the S5 sensor which can be used as a Defrost stop sensor.

On the condenser side, an Sc sensor can be mounted for monitoring of the condenser temperature.

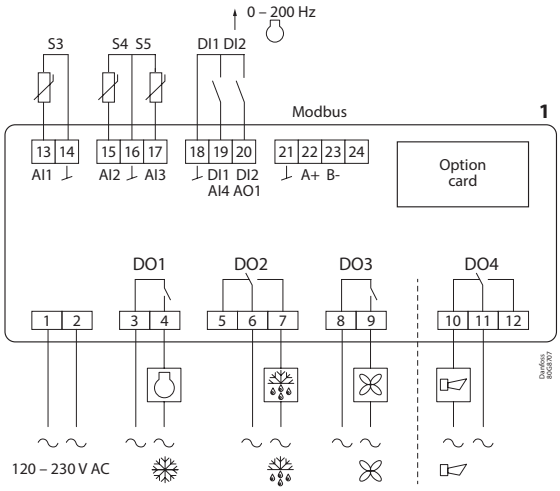
A product temperature sensor (S6) can also be mounted at the load line of the refrigerated cabinet thus representing the food storage temperature.

The outputs will be configured based on the selected application and for the flexible application all in- and outputs can be user defined.

Application coverage

The controller has 4 digital outputs, 2 digital inputs and 3 analogue inputs. However, the digital input DI1 can also be used as an extra analogue input and the digital input DI2 can be used as an analogue frequency output for speed control of a compressor – please refer to the figure below.

Figure: Hardware layout of AK-CC25 Pro



AK-CC25 Pro supports 9 application modes. When selecting an application mode, the inputs and outputs of the controller will automatically be configured. However, for the flexible application mode 9, the user has the option for freely selecting the required in- and output functions and thereby adapt the controller to any application needed. Table 1 shows the relation between the selected application mode and the definition of inputs and outputs.

Table 1: Overview of application mode versus configuration of inputs and outputs. In application 9 the user has the option of free configuration of all inputs and outputs

	Application	DO1 SPST	DO2 SPDT	DO3 SPST	DO4 SPDT	AI1	AI2	AI3	AI4 DI1[1]	AO1 DI2[2]	Modbus
1	Standard case MT/LT (Alarm)					S3	S4	S5	•	•	Built-in
2	Standard case MT/LT (Light)					S3	S4	S5	•	•	Built-in
3	Standard case MT/LT (Rail heat)					S3	S4	S5	•	•	Built-in
4	Case with condenser fan ctrl				cond	S3	S4	S5	Sc	•	Built-in
5	Dual comp. with alarm			2		S3	S4	S5	•	•	Built-in
6	Dual comp. with light			2		S3	S4	S5	•	•	Built-in
7	Dual comp. with rail heat			2		S3	S4	S5	•	•	Built-in
8	Dual comp. with fan			2		S3	S4	S5	•	•	Built-in
9	Flexible case	•	•	•	•	•	•	•	•	•	Built-in

• The Input /Output function can be freely configured.
[1] AI4/DI1 can be used for sensor signals or digital input signals
[2] AO1/DI2 can be used for compressor speed signal (Hz) or digital input signals

The AK-CC25 controller covers multiple plug-in applications with different compressor configurations.

Figure: Single circuit with on/off or variable speed compressor

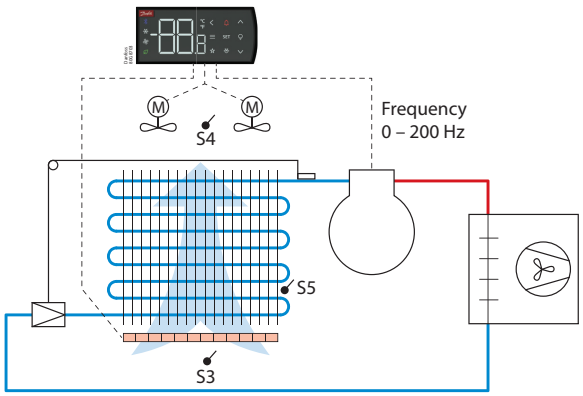


Figure: Single circuit with two on/off compressors

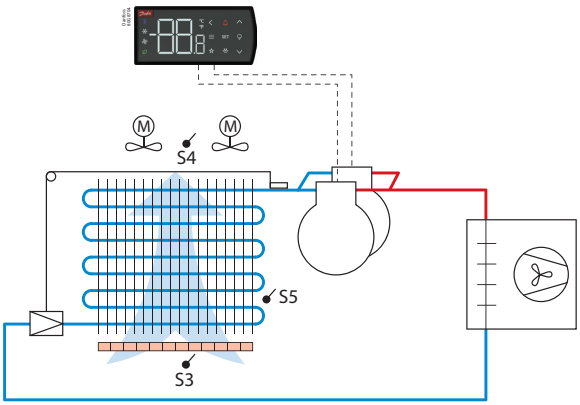


Figure: Dual circuits with separate on/off compressors

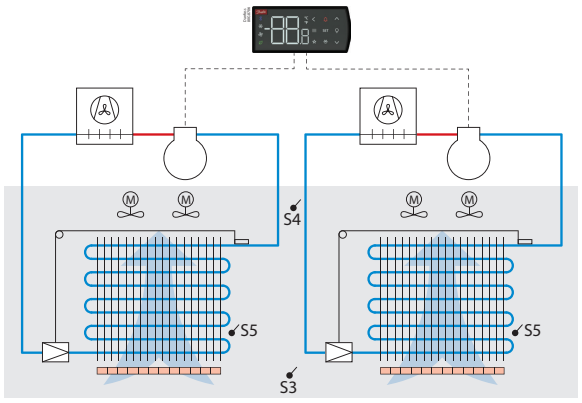


Figure: Remote cabinet with liquid line solenoid valve

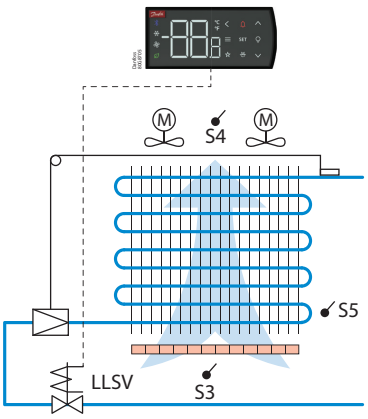
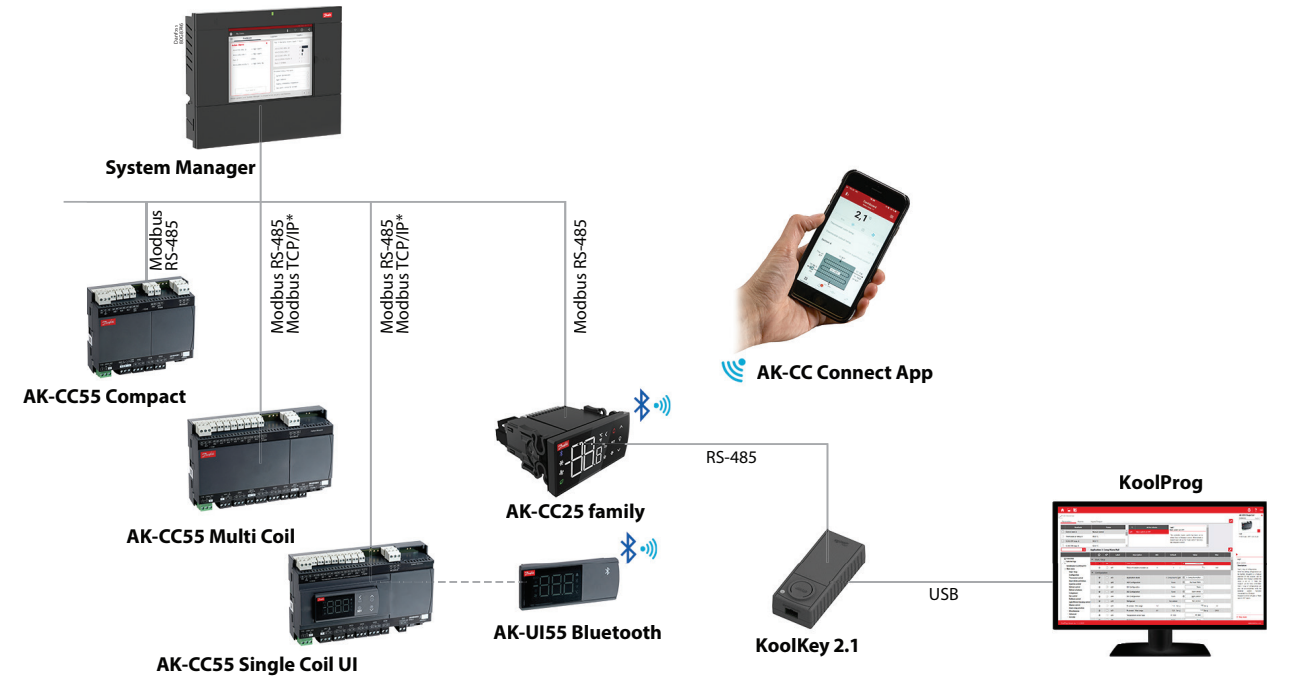


Figure: ECO system



Wired fieldbus

The AK-CC25 controller has a built-in RS-485 Modbus communication and features plug and play integration with the Danfoss AK-SM 800A front end.

For integration with third party front ends, required documentation can be found on Danfoss product store.

Bluetooth

Some models of AK-CC25 have a built in Bluetooth interface for wireless communication with the mobile application "AK-CC Connect", which can be downloaded at the Google Play store (Android) or App Store (iOS).

KoolProg

KoolProg is an OEM tool for offline and on-line programming of the AK-CC25 controller as well as for production line programming of multiple controllers. The KoolKey can be used as a USB / RS-485 converter eliminating the need to connect AC power to the controller while programming. A standard USB/RS-485 converter can also be used, but this will require AC power to operate the controller while performing the programming.

KoolKey 2

Besides working as a USB / RS-485 converter for KoolProg, KoolKey can also be used as a copy key for the AK-CC25 controller. KoolKey just must be connected to the RS-485 port of the controller and then the setting file placed on the KoolKey by KoolProg, is transferred to the controller via a push on the transfer button.

Figure: KoolKey as USB/RS-485 gateway

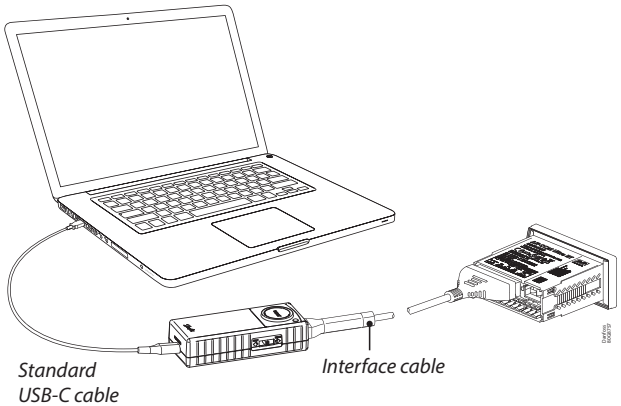
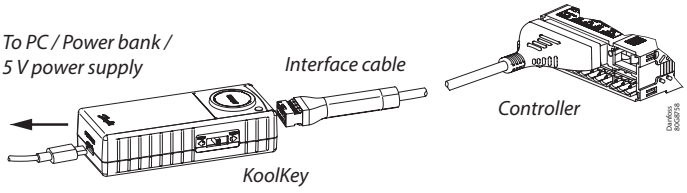
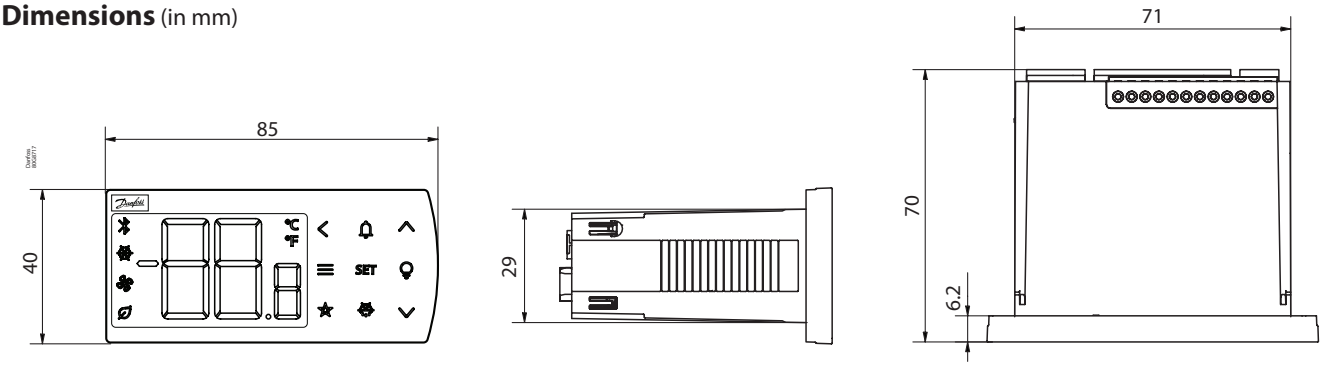


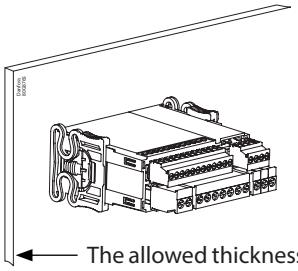
Figure: Controller without main power



Dimensions (in mm)



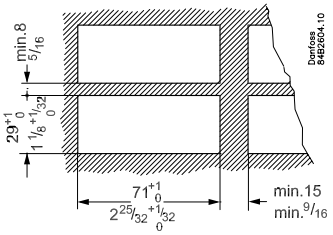
Panel mounting



To guarantee IP65 protection, the controller must be fixated with the mounting brackets pushed tight on to the mounting plate (Force: min. 245 nm per bracket).

Maximum deviation between the edges of the rectangular mounting hole from flat surface: ≤ 0.5 mm (0.02 in)

Maximum roughness of the surface where the gasket is applied: ≤ 120 µm.



The allowed thickness of the mounting plate are min. 0.8 mm (0.03 inch) and max. 18 mm (0.70 inch).

Operation

User interface

Display

The front display features 2 large digits, a smaller decimal digit, and a sign for negative values. It has 3 status icons and 10 capacitive touch buttons that are backlit when active in a given context.

Figure: AK-CC25 front display

Icons	Name	Description
	ECO mode	Lights up when in night/ECO mode
	Cooling	Lights up when cooling
	Fan	Lights when evaporator fans are running
Navigation buttons		
	Back	Navigates back to previous menu
	Up	Navigates up in menu structure Increase value when in setting mode
	Down	Navigates down in menu structure Increase value when in setting mode
	Info menu	Navigates to the controller info menu

Icons	Name	Description
Direct action buttons		
SET	SET	Short press: Change thermostat setpoint Long press: Navigate to parameter menu
	Alarm	Short press: Navigates to list of active alarms Long press while in menu: Reset of alarms
	Light	Long press: Switches light status
	Defrost	Long press: Start/stop of a defrost cycles
	Bluetooth	Long press: Initiate/Terminate Bluetooth connection
	Star	Function can be configured (Not supported yet)

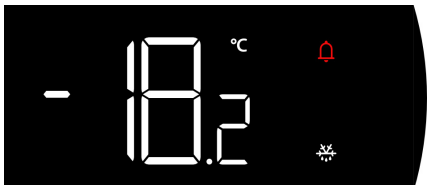
Display modes

The display can be in 3 different operation modes.

Sleep mode

Whenever the display buttons have not been operated for a period of 1 minute, the display will return to the sleep mode, where only the temperature is read-out. If a defrost is on-going or an alarm is raised, the respective button will be lit up to make the user aware of the condition.

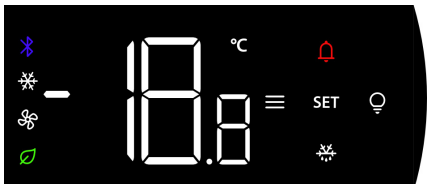
Figure: Display in sleep mode



Direct action mode

If one of the touch buttons are activated, the display changes to direct action mode. In direct action mode all valid buttons become active, and the status icons will show the actual control status.

Figure: Display in direct action mode



When a direct-action button is not active, the backlight will increase and decrease in intensity.
When a direct-action button is active, the backlight will be constantly ON.

Configuration mode
When pressing the "SET" button for 1 second, the display will enter the advanced parameter menu, where all parameters are accessible.

Figure 12: Display in configuration/parameter mode

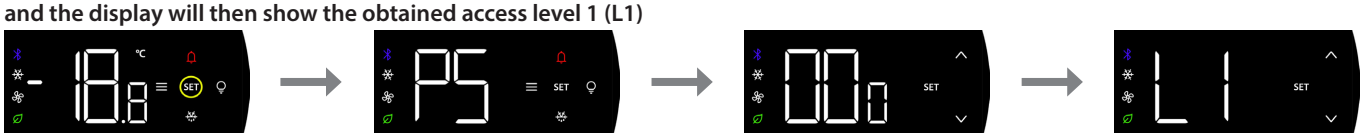
Display operation and related settings

Access levels
AK-CC25 has four access levels that can be configured via the following parameters:

Access level	Parameter	Description
0	---	Access level for walk up users
1	P88 Access code 1	Access to daily operational parameters
2	o64 Access code 2	Access to service parameters
3	o05 Access code 3	Full access to all parameters

If access code 3 has been defined and the user tries to enter the parameter menu, the display will prompt the user for entering an access code. Once the user has entered an access code, the display will show the access level obtained.

Figure 13: The user tries to enter the parameter menu, but as his access level is too low, the display prompts the user to provide a higher-level access code by showing the code "PS" and then a setting entry. The user provides a new access code and presses "SET" and the display will then show the obtained access level 1 (L1)



If the access code for an access level is set to 0, then the user will always have access to this level and the levels below without having to enter an access code. For security reason it is highly recommended to set all three access codes once installed.

Lock / Unlock of display buttons
The operation of the display buttons can be locked to eliminate the risk that walk-up users interact with the display. The display lock functionality is selected via the parameter:

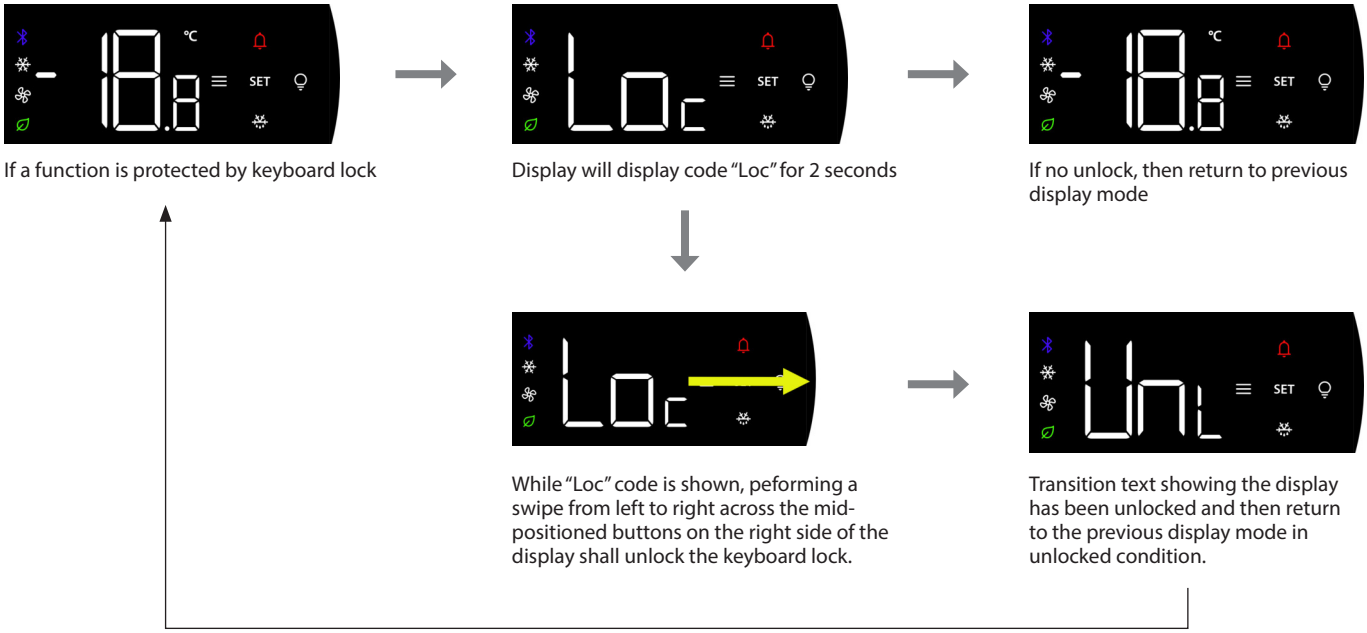
Parameter	Values	Description
P89 Display keyboard lock	0: None	The display buttons are not locked
	1: Local lock	The display buttons will be locked, but can be unlocked locally at the display
	2: Network	The display buttons will be locked and can only be unlocked via the network system manager

If a user presses a button while the keyboard is in locked mode, the display will indicate that it is locked by showing the code "Loc" in the display.

If the buttons are locked locally, the user can unlock the buttons by "swiping" from left to right on the mid-positioned buttons – please refer to example below.

Figure: Unlock display by swipe from left to right

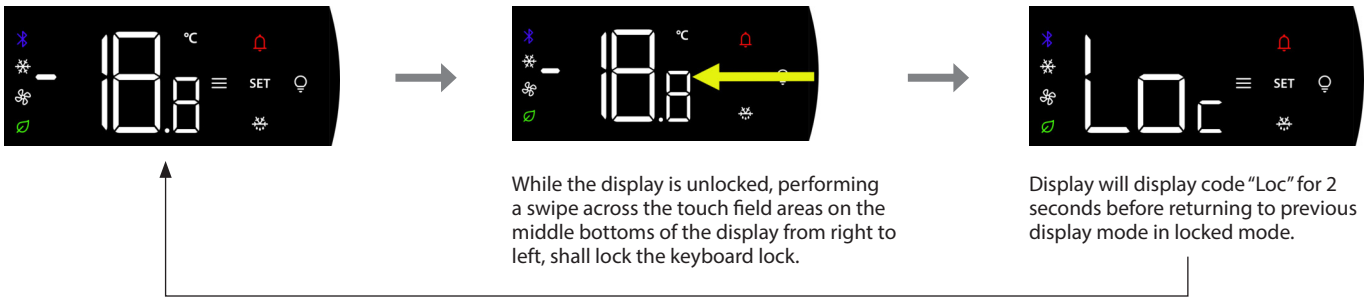
Keyboard is locked



The button lock will be re-activated once the user has not operated the buttons for 1 minute and the display has returned to sleep mode. The user can also lock the buttons again manually by "swiping" from right to left on the mid-positioned buttons.

Figure: Lock display by swipe from right to left

Keyboard is unlocked



If the buttons are locked by the network, then the buttons can only be unlocked at the system manager.

Engineering units

The engineering unit of all temperature readouts °C or °F and settings can be selected via the parameter:

Parameter	Value	Description
r05 Temperature unit	0: Celcius	Temperature values are shown in °C
	1: Fahrenheit	Temperature values are shown in °F

Display temperature readout

The main temperature readout can be selected via the parameter:

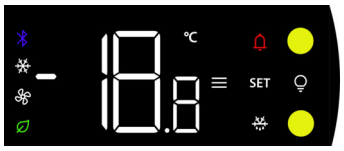
Parameter	Value	Description
o97 Display readout	1: Display air	A display specific weighted value between S3 and S4 sensors
	2: S6	The food product temperature sensor
	3: Ther. air	The thermostat air temperature

Reset to OEM factory settings

All parameter values can be brought back to the OEM saved values, by performing the following procedure:

Figure: Power up controller, and within 1 minute, hold the "Up" and "Down" buttons pressed for 5 seconds. The display will confirm that the reset procedure has been recognized by showing the code "FAc" and subsequently the user must select "YEs" or "No"

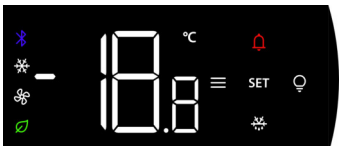
Factory reset



While in direct action mode, pressing and holding the Up and Down buttons for 5 seconds shall initiate OEM factory reset procedure.

The display will confirm the factory reset procedure initiation by showing the text "Fac" for 1 second and then go to user confirmation.

Via up and down button select either "yEs" or "no" and confirm via "SET" button.



When yes is selected, the controller reverts to OEM factory settings.

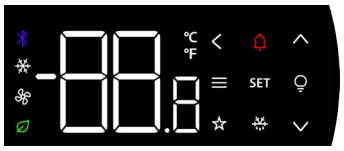
Once a reset to factory has been performed, the controller will restart with the OEM factory values.

Power up sequence

At power up, all buttons, icons and digit segments of the display will be lit up for 2 seconds for check of correct operation. Next, the display will show the software version of the controller before the display finally ends at showing the selected display temperature read-out.

Figure: Power up sequence of controller

1. All icons and buttons are lit up (2 sec)

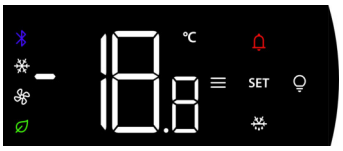


All display segments are lit up for sometime as to be able to check that they all work.

2. SW version is read out (1 sec)

Firmware version is readout, making it easy to check the firmware version when needing support.

3. Display enters direct action mode



The power up sequence end in the display showing the running temperature read-out in direct action mode.

List of possible display codes during operation:

Display code	Description
Err	The temperature cannot be displayed due to a sensor error.
---	Three dashes shown in top – max. value range has been reached.
---	Three dashes shown in middle – Parameter is protected by main switch and cannot be changed until "r12 Main switch" is set in OFF position.
---	Three dashes shown in bottom - Min. value range has been reached.
Loc	The button operation is locked. Unlock by swiping from left to right across the mid-positioned buttons.
UnL	The button operation is unlocked
PS	A higher-level access code is required for performing action.
Fan	A case cleaning procedure is ongoing. The fans are running.
OFF	r12 Main switch has been set in OFF position. A case cleaning procedure is ongoing – all outputs are in standby mode
SEr	r12 Main switch has been set in service mode position for override of outputs
d	Defrost is in progress – the code will be shown a set time after the defrost has ended.
FAC	The reset to OEM factory procedure has been initiated – select Yes to confirm or No to abort.
OP1	Operation mode 1 has been selected
OP2	Operation mode 2 has been selected

Operation via AK-CC Connect APP

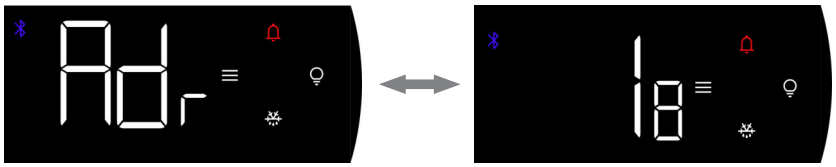
For AK-CC25 Pro BT with wireless Bluetooth, the controller can be operated via the AK-CC Connect App.

The App can be downloaded from Google Play Store or Apple App store.

Google Play Store

Apple App store

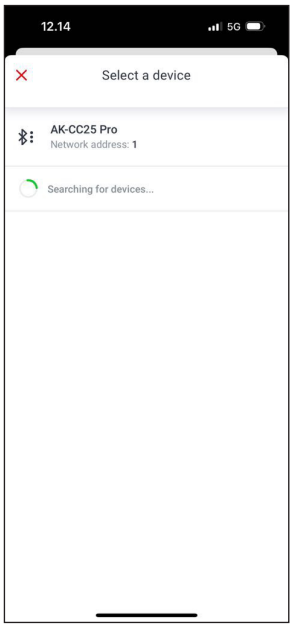
Once the App is installed, initiate the Bluetooth connection by a long press on the Bluetooth button. The display will flash between the code "Adr" and the network address of the controller.



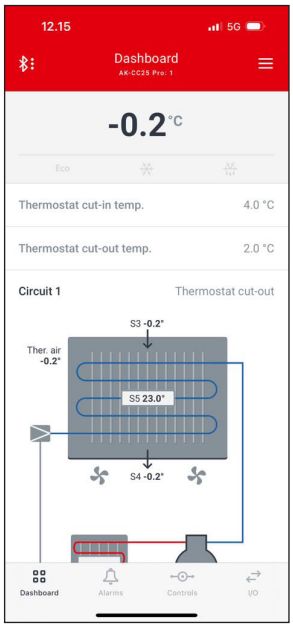
In the connect screen of the App, press 'Connect to controller' and the controller will show up with the network address – select the controller and the App will connect provided a valid access code is given.

Figure: AK-CC Connect App screens

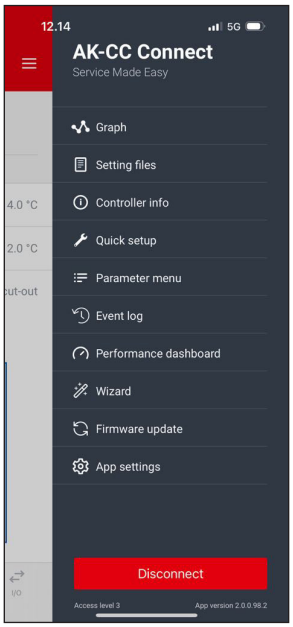
Connect screen



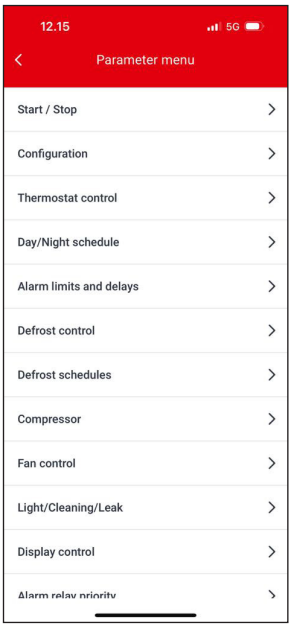
Dashboard



Menu



Parameter screen



Commissioning

Protection of configuration

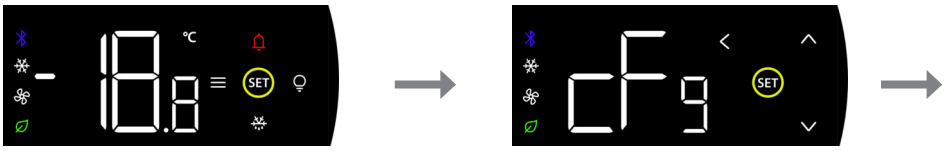
To start the commissioning of the controller, the main switch parameter "r12 Main switch" must be set in OFF position (Factory setting).

The main switch parameter "r12 Main switch" is used to start/stop control and put the controller into service mode allowing for manual override of all outputs. Furthermore, some critical configuration parameters are protected from being changed while Main switch is in start position.

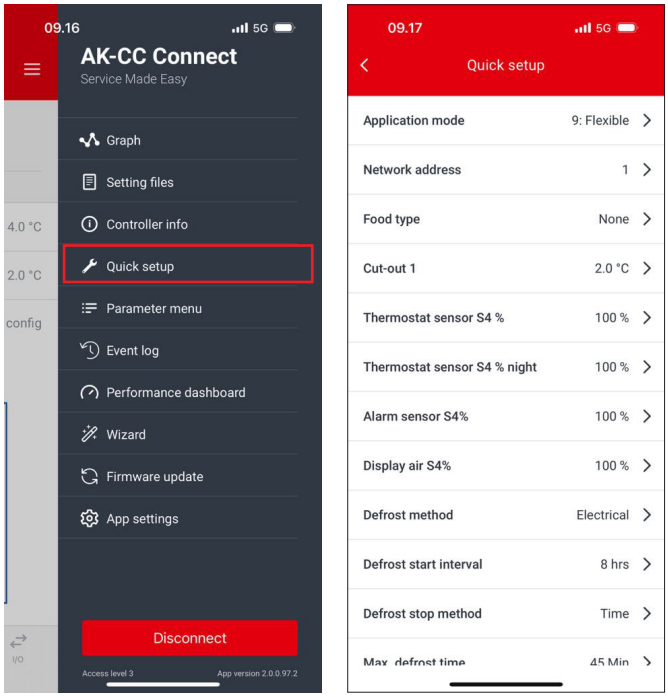
Quick setup

To get a good start it is recommended to use the quick setup for a fast and easy commissioning of the most essential configuration parameters. The quick setup is available on the display interface and the Connect APP interface.

On the display, enter the configuration mode by a long press on the "SET" button and the display will show the code "cFg" for the quick setup menu in the parameter list. Enter the quick setup menu by pressing "SET".



On the Connect APP the quick setup can be accessed through the burger menu entry on the top right side.



For both interfaces the quick setup contains the following parameters:

Label	Name	Description
r12	Main switch	Select the main control mode: 1: Control is started. Critical configuration parameters cannot be changed 0: Control is stopped. Critical configuration parameters can be changed -1: Control is stopped. Outputs can be controlled manually
o61	Application mode	Select one of the 8 pre-configured applications or select the flexible application 9, where all IO can be configured manually
c08	Step control mode	Select how two compressors shall be controlled: 1: Sequential control of two compressors on a s single circuit 2: Cyclic control of two compressors on a s single circuit 3: Two individual compressors running on two separate circuits
o03	Network address	Modbus network address

Label	Name	Description
r05	Temperature unit	Engineering unit for temperature values 0: °C, Celsius 1: °F, Fahrenheit
o06	Sensor types	Select the type of temperature sensors used: 0: Pt1000 1: PTC1000 2: NTC 5k 3: NTC 10k 4: User defined
r89	Food type	Select the food type of the refrigerated produce. When selected, some parameter values will be preset accordingly – please refer to the table below. After selection, food type will revert to "None"
r00	Cut-out	Thermostat cut-out limit
r15	Ther. S4 %	Weighted value of the S4 sensor for the thermostat air temperature at day operation i.e. 50% means 50% of the S4 sensor and 50% of the S3 sensor
r61	Ther.S4% Ngt	Weighted value of the S4 sensor for the thermostat air temperature at night operation i.e. 50% means 50% of the S4 sensor and 50% of the S3 sensor
A36	Alarm S4 %	Weighted value of the S4 sensor for the temperature alarm monitoring i.e. 50% means 50% of the S4 sensor and 50% of the S3 sensor
o17	Display air S4%	Weighted value of the S4 sensor for the display temperature read-out i.e. 50% means 50% of the S4 sensor and 50% of the S3 sensor
d01	Def. method	Select the defrost method: 0: None, no defrost cycles will be performed 1: Electrical defrost 2: Hot gas defrost 4: Natural defrost – only fans will run to defrost evaporator 5: Pulsing electrical defrost
d03	Def.Interval	Maximum time that can pass before a defrost is initiated
d10	DefStopSens.	Select the defrost stop method: Select the defrost stop method: 0: Time, defrost is terminated when the max defrost time has expired 1: S5, defrost is stopped when S5 sensor reaches the stop limit 2: S4, defrost is stopped when S4 sensor reaches the stop limit 3: S5A and S5B, defrost is stopped when both S5 sensors have reached the stop limit. For a dual circuit application, the defrost is stopped individually for each circuit
d04	Max Def.time	The maximum time a defrost cycle can run before it will be terminated
d02	Def.StopTemp	The defrost stop limit – when the selected defrost stop sensor reaches this limit, the defrost is stopped

Table: Food type setting and related preset values

Setting of presettings (r89). After setting 1-5, setting is returned to 0.	1	2	3	4	5
Food type	Vegetables	Milk	Meat/fish	Frozen food	Ice cream
Temperature (r00)	8 °C	0 °C	-2 °C	-20 °C	-24 °C
Max. temp. setting (r02)	10 °C	4 °C	2 °C	-16 °C	-20 °C
Min. temp. setting (r03)	4 °C	-4 °C	-6 °C	-24 °C	-28 °C
Upper alarm limit (A13)	14 °C	8 °C	8 °C	-15 °C	-15 °C
Lower alarm limit (A14)	0 °C	-5 °C	-5 °C	-30 °C	-30 °C
Upper alarm limit for S6 (A22)	14 °C	8 °C	8 °C	-15 °C	-15 °C
Lower alarm limit for S6 (A23)	0 °C	-5 °C	-5 °C	-30 °C	-30 °C

Once the elementary quick settings have been provided, the unit can be started by setting r12 Main switch in ON position, however it is recommended to check the rest of the settings before doing so.

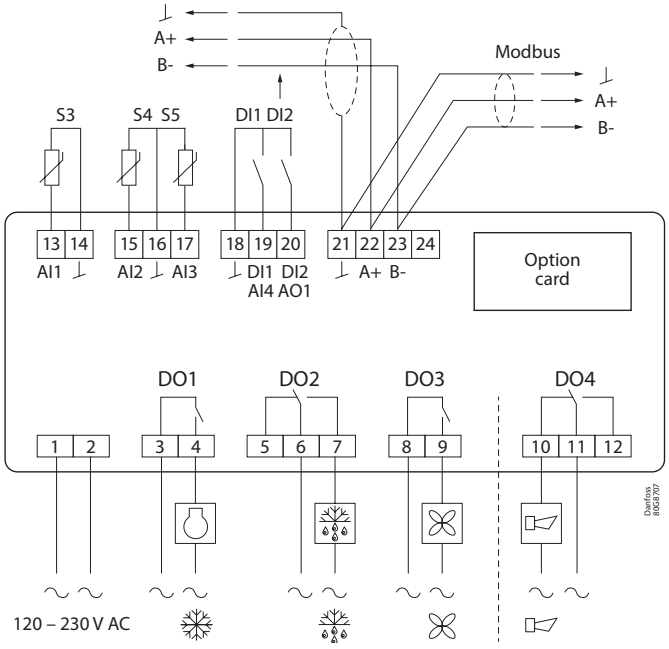
Functions and features

Functions summary

- Single refrigeration circuit with single or dual compressor
- Dual refrigeration circuits with individual compressors
- Modulating temperature control via capacity control of variable speed compressor
- Variable speed control via frequency signal
- Oil return management for extended lifetime of VSC compressor
- Resonance avoidance range for eliminating mechanical noise from unit
- Temperature and operational performance monitoring
- Safety monitoring of condenser temperature and compressor safety chain with option of lock-out if safety limits are violated repeatedly
- Switch between MT and LT operation modes via digital input or display
- Start of defrost via schedule, runtime, digital input, network or setting display
- Natural, electrical, hot gas or pulsing electrical defrost
- Stop of defrost on time and/or temperature
- Coordination of defrosting among several controllers in a line-up
- Pulsing control of fans when thermostat is satisfied
- Appliance cleaning function for documentation of HACCP procedure
- Rail heat control via day/night load or dew point
- Door function and alarm monitoring
- Light control according to schedule, door signal or network signal
- Heating thermostat
- High accuracy inputs guaranteeing a better measuring accuracy than stated in the standard EN ISO 23953-2 without subsequent calibration (Pt1000 ohm sensor)
- Integrated MODBUS communication

Applications

The general wiring diagram of the AK-CC25 controller is shown below:



Overall, the hardware features the following IO:

- 4 digital outputs
- 2 digital inputs
- 4 analogue inputs (AI4 is mutual exclusive with DI1)
- 1 Analogue output (AO1 is mutual exclusive with DI2)

The AK-CC25 controller has 9 application modes. For the application modes 1-8, most of the input and output functions are pre-defined making it fast and foolproof to configure the controller. However, application 9 offers a fully flexible IO configuration where all input and output functions can be defined by the user – please refer to the table 4 below for further details.

The application mode is set via the parameter:

Parameter	Description
o61 Application mode	Selection of application mode as per table above

The selection gives the following IO configurations:

Table: Overview of application modes and IO configuration

	Application	DO1 SPST	DO2 SPDT	DO3 SPST	DO4 SPDT	AI1	AI2	AI3	AI4 DI1[1]	AO1 DI2[2]	Modbus
1	Standard case MT/LT (Alarm)					S3	S4	S5	•	•	Built-in
2	Standard case MT/LT (Light)					S3	S4	S5	•	•	Built-in
3	Standard case MT/LT (Rail heat)					S3	S4	S5	•	•	Built-in
4	Case with condenser fan ctrl				cond	S3	S4	S5	Sc	•	Built-in
5	Dual comp. with alarm			2		S3	S4	S5	•	•	Built-in
6	Dual comp. with light			2		S3	S4	S5	•	•	Built-in
7	Dual comp. with rail heat			2		S3	S4	S5	•	•	Built-in
8	Dual comp. with fan			2		S3	S4	S5	•	•	Built-in
9	Flexible case	•	•	•	•	•	•	•	•	•	Built-in

• The Input /Output function can be freely configured.
[1] AI4/DI1 can be used for sensor signals or digital input signals
[2] AO1/DI2 can be used for compressor speed signal (Hz) or digital input signals

Applications 1-4

These are typical applications for a single refrigeration circuit with on/off or variable speed compressor. To use a variable speed compressor the analogue output AO1 must be set for compressor speed control.

Applications 5-8

These are applications for either a single refrigeration circuit with dual on/off compressors or for a cabinet with two individual refrigeration circuits each having an on/off compressor. Which of the applications is decided by the parameter c08:

Parameter	Description
c08 Step control mode	1: Single refrigeration circuit with sequential control of two compressors (FILO) 2: Single refrigeration circuit with cyclic control of two compressors (FIFO) 3: Dual refrigeration circuits, each having an on/off compressor

Application 9

For this flexible application mode, the function of all inputs and outputs can be defined individually.

Digital outputs:

For the four digital outputs the function is selected via the parameters:

Parameter	Description
q01 DO1 Configuration	Select function for DO1 output
q02 DO2 Configuration	Select function for DO2 output
q03 DO3 Configuration	Select function for DO3 output
q04 DO4 Configuration	Select function for DO4 output

Table: Selectable digital output functions

Value	Function
0	None
1	Fan
3	Defrost A
4	Rail heat
5	Alarm
6	Light
8	Compressor/LLSV
9	Compressor 2
10	Air heater
12	Condenser fan
13	Drain heater
14	Defrost B

Hints:
It is recommended to use DO1 for compressor start/stop as this relay has the highest current ratings.

If AO1 is used for a variable speed compressor and it supports stopping the compressor via the frequency signal, then a digital output can be left out for start and stop of the compressor.

It is recommended to configure the alarm and light functions on the digital outputs with double contact set (DO2 or DO4) as they must be connected to the NO contact, so that the light will be switched ON and an alarm will be raised if the power to the controller should fail.

Digital inputs:

For the two DI inputs DI1 and DI2, the function is selected via the parameters:

Parameter	Description
o02 DI1 Configuration	Select function for DI1 input
o37 DI2 Configuration	Select function for DI2 input

Table: Selectable digital output functions

Value	Function	DI1[1)]	DI2[2)]
0	None	x	x
1	DI status only	x	x
2	Door function (stop of refrigeration and fans)	x	x
3	Door alarm	x	x
4	Defrost start	x	x
5	Main switch	x	x
6	Night setback	x	x
8	Alarm at closed	x	x
9	Alarm at open	x	x
10	Case cleaning	x	x
11	Forced cooling	x	x
13	Co-ordinated defrost		x
15	Shutdown	x	x
16	Light control	x	x
20	Leak detection	x	x
24	Compressor 1 safety	x	x
29	Door fans stop	x	x
31	Compressor 2 safety (only used at dual circuits)	x	x
32	Temperature pulldown – quick freeze	x	x
33	Operation mode (MT/LT)	x	x

[1)] If the analogue input AI4 is configured for a function, DI1 will not be available.
[2)] If the analogue output AO1 is configured for a function, then DI2 will not be available.

Analogue output

For the single AO output, the function is selected via the parameter:

Parameter	Description
q09 AO1 Configuration[1)]	Select function for AO1 output

[1)] If the analogue output AO1 is configured for a function, then DI2 will not be available.

Table: Selectable analogue output functions

Value	Function
0	None
3	Variable speed compressor

A variable speed compressor can only be defined for a single compressor application. If two compressors have defined the analogue output cannot be configured for variable speed control.

Analogue inputs

For the four analogue inputs, the functions are selected via the parameters:

Parameter	Description
q60 AI1 Configuration	Select function for AI1 input
q61 AI2 Configuration	Select function for AI2 input
q62 AI3 Configuration	Select function for AI3 input
q63 AI4 Configuration[1)]	Select function for AI4 input

[1)] If the analogue input AI4 is configured for a function, DI1 will not be available.

Table: Selectable analogue input functions

Value	Function
0	None
3	S3 Air ON evap. (before evaporator)
4	S4 Air OFF evap. (after evaporator)
5	S5A Evaporator sensor
6	S6 Product sensor
10	S5B Evaporator sensor
15	Sc Condenser sensor

Handling of illegal IO configurations

If an illegal IO configuration has been made, a "Wrong IO config" alarm will be raised, and the control cannot be started.

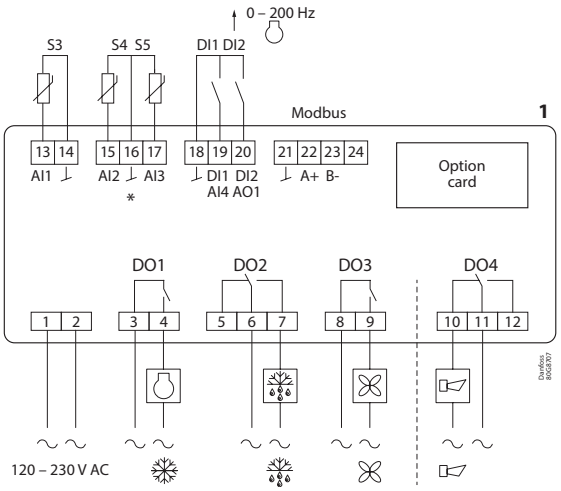
If the controller has been set up for using a specific sensor and the sensor has not been configured, a "Wrong IO config" alarm will be raised and a sensor alarm will be raised for the missing sensor.

Please refer to Appendix A for further details on illegal IO configurations.

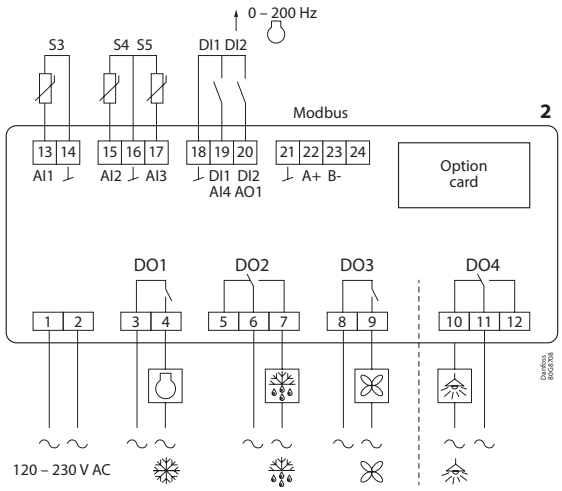
Wiring diagrams

Wiring diagrams for the 8 pre-defined configurations is provided here:

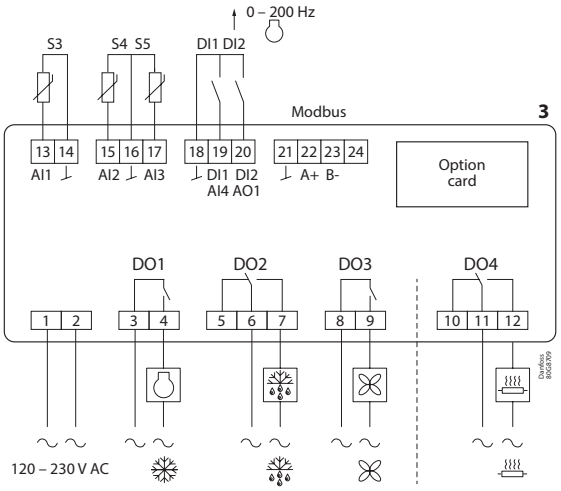
Application 1



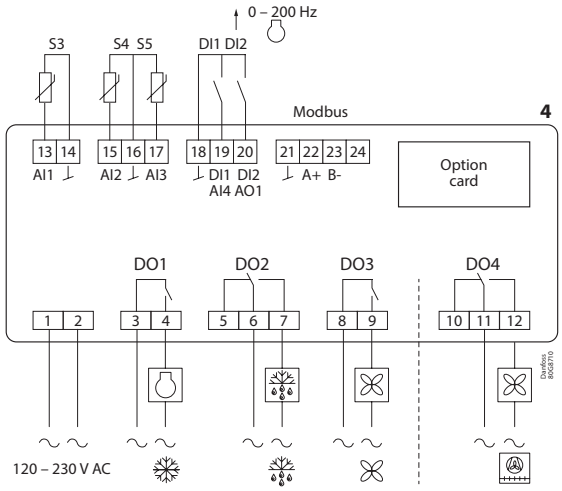
Application 2



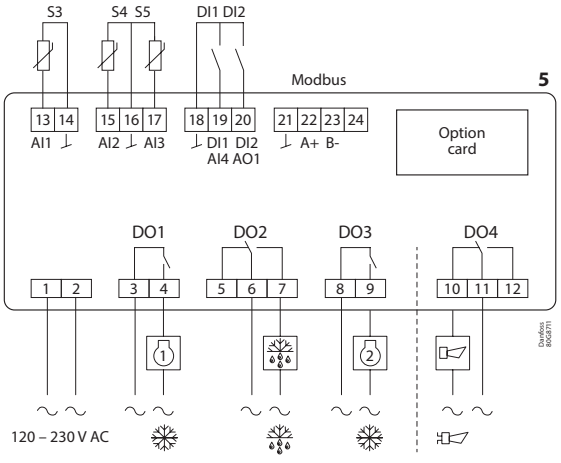
Application 3



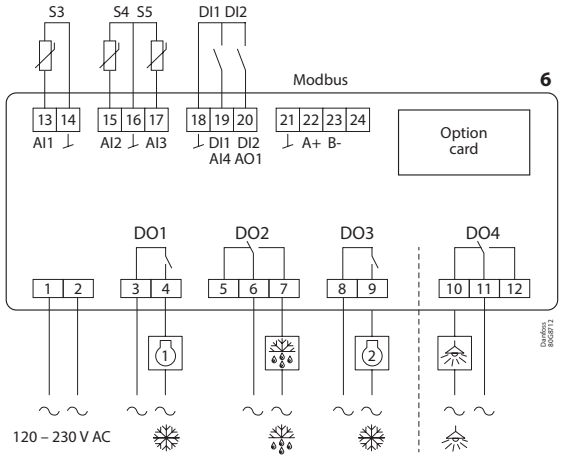
Application 4



Application 5

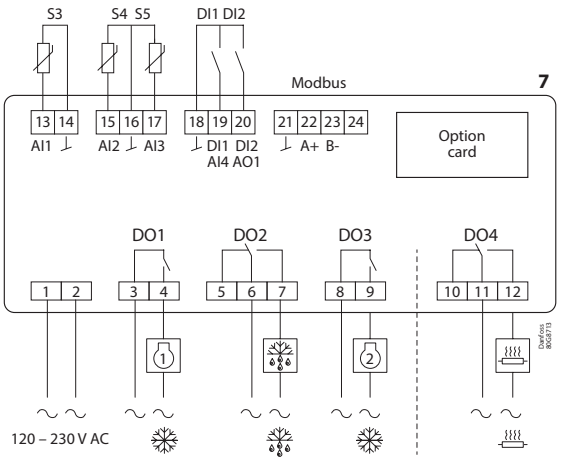


Application 6

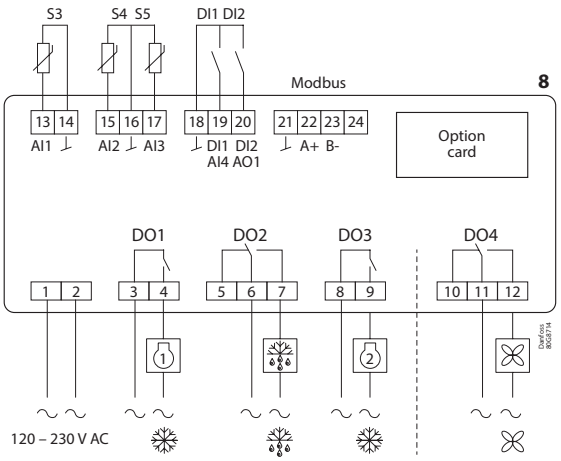


***Note:** Each AI/DI/AO signal must have a separate ground wire.

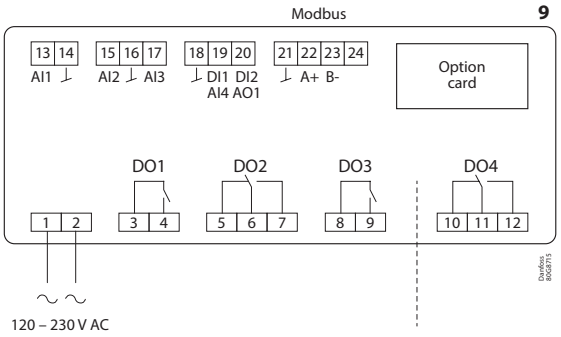
Application 7



Application 8



Application 9

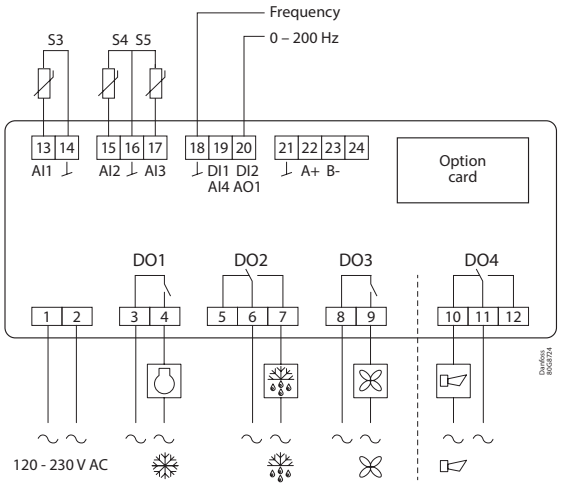


Special wiring details

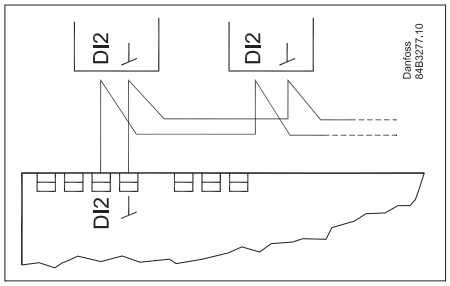
Variable speed compressor

In applications 1-4 and 9., the analogue output AO1 can be set up for a variable speed compressor. The analogue output will provide a frequency signal for control of the VSC on terminals 18 – 20.

⚠ **Warning:** The ground wire of frequency signal shall be separate from the ground wire of DI1/AI4 signal.



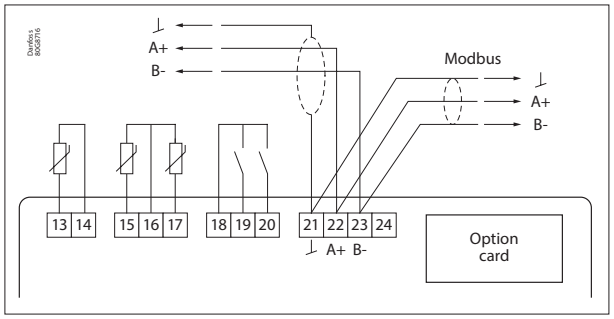
Coordinated defrost via cable connections



Max. 10
The following controllers can be connected in this way:
EKC 204A, AK-CC 210, AK-CC 250,
AK-CC 450, AK-CC 550 and AK-CC55.

Refrigeration is resumed at the same time when all controllers have terminated defrost.

Data communication



It is important that the installation of data
Communication cable is performed correctly
With sufficient distance to high voltage cables.
For more information, refer the Communications Design Guide.

Installation considerations

Accidental damage, poor installation, or site conditions can give rise to malfunctions of the control system, and ultimately lead to a plant breakdown.

Every possible safeguard is incorporated into our products to prevent this. However, a wrong installation could still present problems. Electronic controls are no substitute for normal, good engineering practice.

Danfoss will not be responsible for any goods, or plant components, damaged as a result of the above defects. It is the installer's responsibility to check the installation thoroughly, and to fit the necessary safety devices.

Your local Danfoss agent will be pleased to assist with further advice, etc.

For security reasons the connection terminals and cable runs of the Modbus data communication cable shall be placed in physical restricted area, where only authorized personnel has access.

Electric noise

Cables for sensors, low voltage DI inputs and data communication must be kept separate from other electric cables:

- Use separate cable trays
- Keep a distance between cables of at least 10 cm
- Long cables at the low voltage DI input should be avoided

Technical data

Mechanical	
Enclosure	Self-extinguishing polycarbonate
Environmental conditions	
Ingress protection	Panel mounting with fixing mounting brackets EN: Front IP65, Back IPX0 UL: Type 1
Operating temperature	-20 – 55 °C; 20 – 80 rH% (non-condensing humidity)
Storage temperature	-40 – 70 °C; 20 – 80 rH% (non-condensing humidity)
Electrical specifications	
Purpose of control	Electrical control device
Power supply	100 – 240 V AC
Power consumption	3 V A
Frequency	50/60 Hz
Terminal blocks	L, N, DO1, DO2, DO3, DO4 Removable male-female 12 – 24 AWG / 0.34 – 2.5 mm^2
	AI1-AI3, DI1-DI2 Removable male-female 16 – 28 AWG / 0.081 – 1.5mm^2
	Modbus: Removable male-female 16 – 28 AWG / 0.081 – 1.5 mm^2
Rated impulse voltage	2500 V
Overvoltage category	II
Construction of control	Incorporated control
Environmental pollution class	2
User interface	
Display	3 digits, decimal point and multifunction icons
Keypad	10 backlit capacitive touch buttons
Status icons	3 backlit icons
Connectivity	
Bluetooth	Bluetooth Low Energy ver. 5.1, max. distance 10 m, variable according to the mobile device used
Fieldbus	RS-485 Transceiver oktal load. (allows up to 256 units), Non isolated Speed: up to 115.2 kbps, Fail safe: means accept 0 V on bus line, Cable length: ≤1200 m
Analogue inputs (AI1-AI4)	
Sensor types	Pt1000, (AKS 11, AKS 12, AKS 21) PTC 990 Ohm at 25 °C NTC 5K Ohm at 25 °C, (EKS 211) NTC 10K Ohm at 25 °C, (EKS 221) User defined type
Measuring range	Pt1000: -60 – 120 °C PTC1000: -60 – 80 °C NTC 5K: -40 – 80 °C NTC 10K: -40 – 120 °C User defined type: 400 – 200k ohm **Note:** Each AI/DI/AO signal must have a separate ground wire.
Accuracy	Pt1000: ±0.5 K PTC 1000: ±0.5 K NTC 5K: ±0.5 K NTC 10K: ±0.5 K
Digital inputs (DI1-DI2)	
DI1	Dry contact, Open loop. 3.3 V DC, contact current. 2.2 mA
DI2	Dry contact, Open loop. 12 V DC, contact current. 3.5 mA OBS: Defrost co-ordination: max. 5 controllers in parallel, max. 100 m cable total.

Analogue output (AO1)			
AO1	Frequency: 0 – 200 Hz (min. 0 V and max. 12 V) Sink: -50 mA, cable length < 30 m		
Digital outputs (DO1-DO4)			
Terminals / Action type	**Load type**	**EN Ratings**	**UL ratings**
DO1, 3-4 (NO) DO2, 5-6-7 (NO/NC) Type 1.B	Resistive	NC/NO: 10 A, 240 V AC	NC/NO: 10 A resistive 240 V AC
	Motor compressor	DO1: 10A (cos ϕ = 0.6), 240 V AC DO1/DO2: 3.5A (cos ϕ = 0.4), 240 V AC	NO: 1 1/2 HP or 10FLA/60LRA 240 V AC NC/NO: 1/2 HP 125 V AC NC/NO: 1HP 240 V AC
	Inductive	Not rated for this load type	NO: Pilot duty: B300
	Lamp elect. ballast	Not rated for this load type	DO1: NO: TV-5, 125 V AC DO2: NO: TV-5, 240 V AC
DO3, 8-9 (NO) DO4, 10-11-12 (NC/NO) Type 1.B	Resistive	NC/NO: 6A resistive, 240 V AC	NC/NO: 6A resistive, 240 V AC
	Motor compressor	NC/NO: 3A (cos ϕ 0.4), 240 V AC	1/4 HP 125/240 V AC
	Inductive	NC/NO: 6(4), 240 V AC	NC/NO: Pilot duty: B300
	Lamp elect. ballast	Not rated for this load type	NO: TV-4, 120/240 V AC
Others			
5 V DC Supply Supply for external accessories	Total load from all external accessory: max 50 mA Cable length: ≤3 m		
Real time clock	Accuracy. typ. 20 ppm, 10 min/year Back-up time 4 days		
Conformity			
LVD directive and UL certification	IEC/EN/UL 60730-1, IEC/EN/UL 60730-2-9		
EMC directive	IEC/EN 61000-6-1, IEC/EN 61000-6-2, IEC/EN 61000-6-3, IEC/EN 61000-4		
Flammable refrigerants *Approved for use in Zone 2 (gases Zone) as per 2014/34/EU ATEX directive*	Compliance with the following requirements of the IEC 60335 standards: • Components that produce sparks during the normal operation have been tested for enclosed break "dC" device as per IEC/EN 60079-1:2014 and for seal tight "nC" device tested according to IEC/EN 60079-15:2019, which meets requirement of Annex BB of EN 60335-2-89 and Annex CC of EN 60335-2-24. • Annex 101.DVL and clause 22.114DV D2 of UL60335-2-89. • IEC/EN/UL 60335-2-89 (Annex BB) for commercial refrigeration appliances. • IEC/EN/UL 60335-2-24 (Annex CC) for household refrigerator appliance • Complementary file LZGH2/8 (Flame Arrest-protected Components for Use in Refrigeration and Air-Conditioning Equipment Employing A2L Refrigerants).		
Wireless	RED directive, FCC/IC 47 CFR Part 15, subsections B, C		

Functions

Main switch

To start the commissioning of the controller, the main switch parameter "r12 Main switch" must be set in OFF position (Factory setting).

The main switch parameter "r12 Main switch" is used to start/stop control and put the controller into service mode allowing for manual override of all outputs. Furthermore, some critical configuration parameters are protected from being changed while Main switch is in start position.

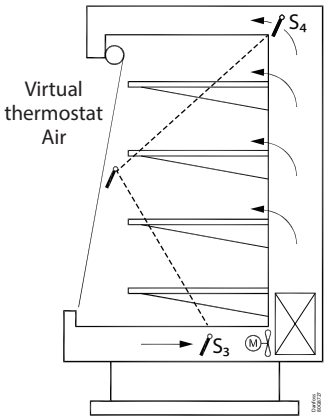
Parameter	Value	Description
r12 Main switch	-1:	Manual control of outputs can be performed
	0:	Stop of control
	1:	Start of control

A digital input can also be set up for main switch function and thereby start/stop of control.

Temperature control

Thermostat temperature

The temperature in the appliance is registered by one or two temperature sensors located in the return air before the evaporator (S3) or after the evaporator (S4) respectively.



Sensor	Description
S3	Return air temperature
S4	Supply air temperature

The thermostat air temperature is based on a weighted percentage value between the S3 sensor and S4 sensor. A setting determines how much the S4 sensor shall weigh in the thermostat air temperature e.g. if the S4 weight is set to 30%, then the S3 weight is 70%.

If a night cover or night curtains are used, then a separate weighted percentage value can be set for night operation.

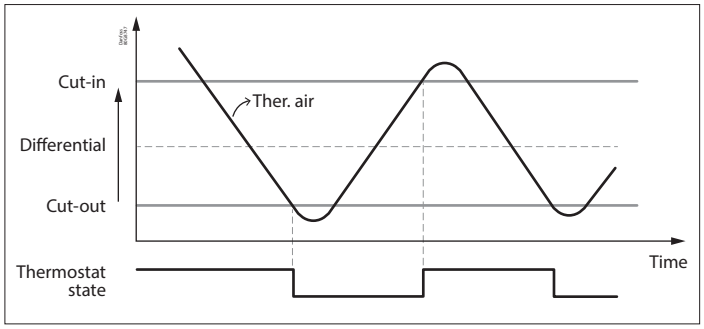
Parameter	Value	Description
r15 Thermostat sensor S4 %	0-100%	Weight of S4 sensor in thermostat air temp. during day
r61 Thermostat sensor S4 % night	0-100%	Weight of S4 sensor in thermostat air temp. during night
u17 Ther. air		Actual thermostat air temperature

Thermostat control

The temperature control is based on a thermostat cut-out setpoint and a differential.

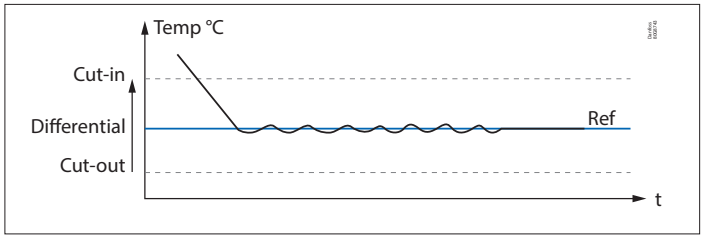
When using on/off compressors, the compressor is cut-out when the thermostat air temperature reaches the set cut-out limit and will be started again when the thermostat air temperature has increased with the set differential – please refer to the figure below.

Figure: Temperature control with on/off compressors



When using a variable speed compressor, the capacity of the compressor is adapted to keep the temperature at the mid-point between the cut-in and cut-out limits.

Figure: Temperature control with variable speed compressor



The actual cut-in time of the thermostat and the actual working cut-in and cut-out temperature limits of the thermostat can be read-out.

Parameter	Value	Description
Parameter	Value	Description
r00 Cut-out 1	-60 – +50 °C	Set point for thermostat cut-out
r01 Differential	0.1 – 20 K	Temperature differential for thermostat
r14 Thermostat mode	Read-out	1: ON/OFF control 2: Modulating control with variable speed compressor
u90 Ther. cut-in temp.	°C	Actual cut-in limit for thermostat
u91 Ther. cut-out temp.	°C	Actual cut-out limit for thermostat
u18 Ther. run time A	min	Actual/last runtime of thermostat

To prevent that the thermostat setpoint is adjusted too much, the setting range of the cut-out limit can be limited via the parameters:

Parameter	Value	Description
r02 Max cut-out limit	-60 – +50 °C	Maximum setting range for cut-out temperature
r03 Min cut-out limit	-60 – +50 °C	Minimum setting range for cut-out temperature

Emergency control

In case the thermostat control sensor becomes defective, the temperature control will go into an emergency control state, where the temperature is controlled based on a control pattern learned during normal control.

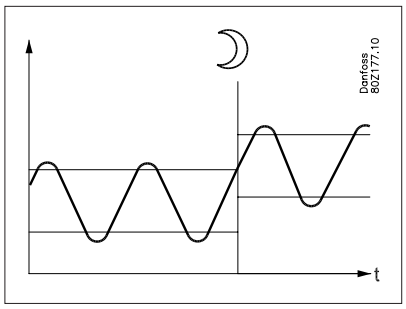
For on/off compressors, the thermostat will operate with the registered ON/OFF duty cycle during day and night operation.

For a variable speed compressor, the compressor will run with a capacity registered during day and night operation.

Night setback

In refrigeration appliances there may be big load differences between the shop's opening and closing hours, especially if night lids/blinds are used. The thermostat reference may be raised here without it having any effect on the product temperature.

Figure: Night offset via a digital input signal



Parameter	Value	Description
r13 Night offset	-50 – +50 °C	Thermostat night offset
u13 Night condition	Read-out	State of night operation

Change-over between day and night operation can take place as follows:

- Via an internal night event schedule
- Via an external switch connected to a digital input.
- Via a network signal from the system manager

Night event schedule

Two daily scheduled events can be defined and associated to different weekdays. For each event, the user shall be able to define a time for opening of the store (daytime) and a time for closing of the store (Nighttime). Besides these two scheduled events, the user can select pre-defined events for a full day closed and a full day open.

For each weekday, the user shall be able to define which event that applies to the weekday in question - either "Open all day", "Closed all day", "Event 1" or "Event 2".

Parameter	Value	Description
t58 Event 1 Day	0 – 23 Hours	Event 1 - Start of daytime - Hours
t59 Event 1 Day	0 – 59 min	Event 1 - Start of daytime - Minutes
t60 Event 1 Day	0 – 23 Hours	Event 1 - Start of night-time - Hours
t61 Event 1 Day	0 – 59 min	Event 1 - Start of night-time - Minutes
t62 Event 2 Day	0 – 23 Hours	Event 2 - Start of daytime - Hours
t63 Event 2 Day	0 – 59 min	Event 2 - Start of daytime - Minutes
t64 Event 2 Day	0 – 23 Hours	Event 2 - Start of night-time - Hours
t65 Event 2 Day	0 – 59 min	Event 2 - Start of night-time - Minutes
t66 Monday event	0: Open all day 1: Closed all day 2: Event 1 3: Event 2	Select event for Monday
t67 → t72	As above	Select daily events for Tuesday to Sunday

Example:

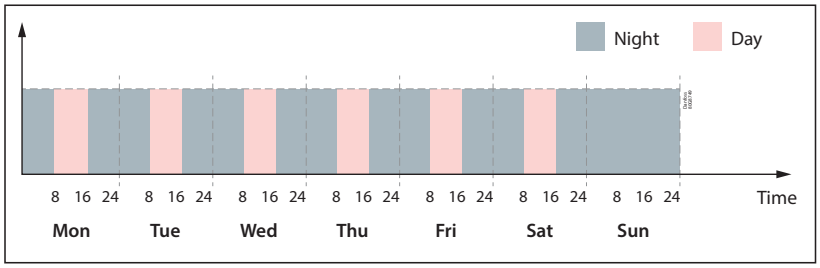
Event 1
Daytime 08:00
Night-time 16:00

Event 2
Daytime 09:00
Night-time 20:00

Monday to Friday: Event 1
Saturday: Event 2
Sunday: Night all day

Based on the above, the weekly night schedule will be as shown in the figure below.

Figure: Weekly night schedule based on defined events

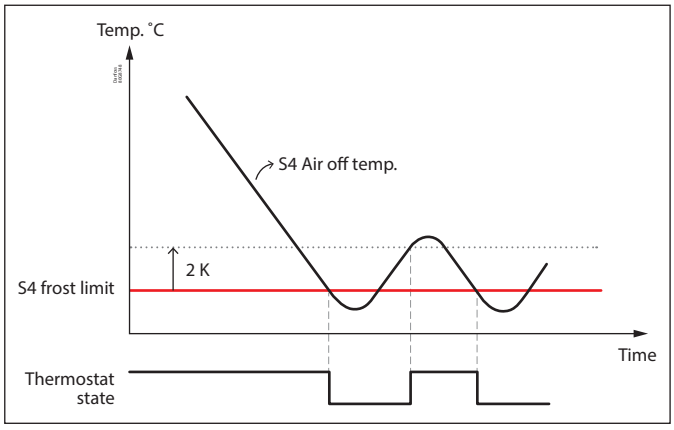


Frost protection

In some type of cabinets, there is a risk of freezing up food stuff stored at the back of the shelfs and the frost protection feature eliminates this risk.

If the measured S4 air off evap. temperature decreases below the set frost limit, refrigeration is stopped immediately and the S4 air off evap. temperature must increase with 2K above the set frost limit for refrigeration to be resumed – please refer to the figure below.

Figure: Frost protection eliminates the risk of freezing up stored food as cooling is stopped at frost protection limit



The frost protection function is enabled by setting the frost protection limit to a value higher than the default value of -60 °C.

Parameter	Value	Description
r98 S4 frost protection	-60 – 50 °C	Frost protection limit where cooling is stopped

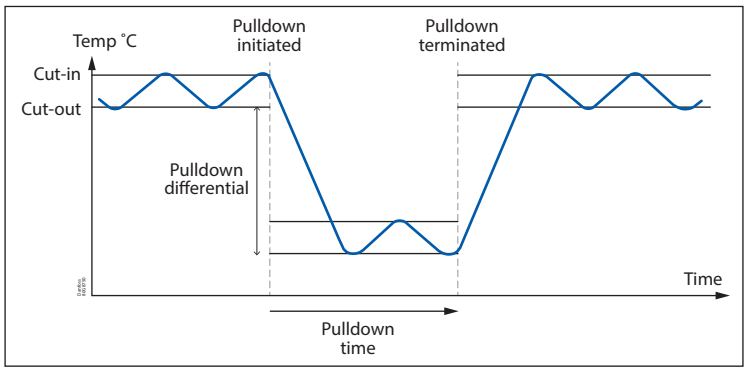
Temperature pulldown – quick freeze

When loading a cabinet with warm goods, the air temperature in the cabinet/Cold room will increase and it will take some time for the goods to reach the ideal storage temperature. To minimize the time for the goods to reach the ideal storage temperature, the user shall be able to initiate a temperature pulldown cycle where the air temperature for a period is cooled to a lower level than during normal thermostat control

A temperature pulldown cycle can be initiated via:
- A toggle switch signal on a digital input
- A direct-action function ("Pdt") in the info menu of the display
- After a defrost cycle to bring down the goods temperature quickly

When a pulldown cycle is initiated the thermostat cut-out value will be offset with set pulldown temperature differential compared to the actual thermostat cut-out value. So, during a pulldown cycle the thermostat will run with a lower setpoint for a set pulldown time. When the set pulldown time expires, the pulldown cycle is terminated even if the pulldown temperature has not been reached and the thermostat will revert to the normal cut-out value for temperature control - please refer to figure below.

Figure: Temperature pulldown cycle

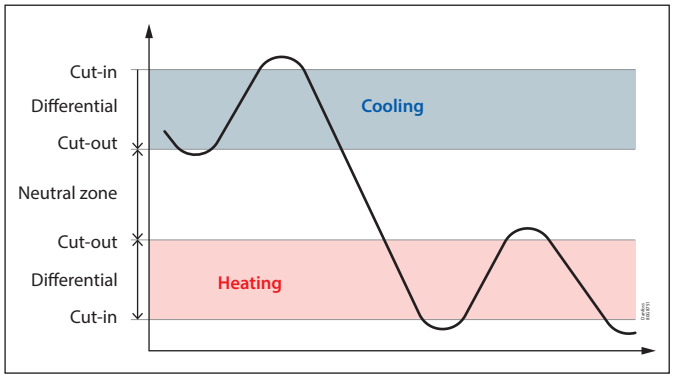


Parameter	Value	Description
ra1 Temp. pulldown diff	-50 – 0 °C	Temperature differential for pulldown
ra2 Temp. pulldown time	0 – 300 min	Duration of temperature pulldown
d44 Pulldown after defrost	No/Yes	Perform pulldown after a defrost cycle

Heating thermostat

The heating thermostat is enabled by defining one of the digital outputs for air heater control. The heating function is used to prevent the temperature from becoming too low, e.g. in a cold room, etc. The limit for when the heating function cuts off is set as an offset value below the current cut-out limit for the refrigeration thermostat. This ensures that refrigeration and heating do not occur simultaneously. The difference for the heating thermostat has the same value as for the refrigeration thermostat. To prevent that the heating thermostat cuts in during short-term drops in air temperature, a time delay can be set for when to change from refrigeration to heating.

Figure: Heating is started when the temperature has dropped the set neutral zone and differential below the cooling thermostat cut-out limit



Parameter	Value	Description
r62 Air heater neutral zone	0 – 50 °C	Neutral zone between cooling and heating zones
r63 Air heater start delay	0 – 240 min	Delay for start of first heating cycle
u84 Air heater	OFF/ON	Readout of air heater status

Melt function

This function will prevent the air flow in the evaporator from being reduced by large ice crystals created on the evaporator fins by uninterrupted operation for a long time e.g. at variable speed compressor. The function is activated if the thermostat air temperature has remained in the range between -5 °C and +10 °C for a longer period than the set melting interval. The refrigeration will then be stopped during the set melting period. The frost will be melted so that the air flow and hence the evaporator's capacity will be greatly improved. This also allows for longer intervals between required defrost cycles.

Parameter	Value	Description
r16 Melt interval	0 – 10 hours	Interval between melt periods if cooling is running constantly
r17 Melt period	0 – 30 min	Duration of melt period

Food temperature and product sensor

Several sensors can be selected to represent the temperature of the refrigerated goods.

A separate optional product sensor S6, which can be configured on one of the analogue inputs, can also be used and can register and monitor the food temperature in the appliance.

Parameter	Value	Description
q39 Food temp. sensor	1: Thermostat air 2: Alarm air 3: S3 Air ON sensor 4: S6 Product sensor	Interval between melt periods if cooling is running constantly. Select temperature sensor/value representing the food temperature.
U72 Food temperature	°C	Readout of selected sensor value
u36 S6 product temp.	°C	Readout of product sensor value

Temperature alarm monitoring

Just as is possible for the thermostat, the alarm monitoring can be set with a weighting between S3 and S4 so that you can decide how much the two sensor values should influence the alarm monitoring. Minimum and maximum limits can be set for alarm temperature and time delays. A longer time delay can be set for high temperature alarm at pulldown conditions like after defrosting, after appliance cleaning and after start-up.

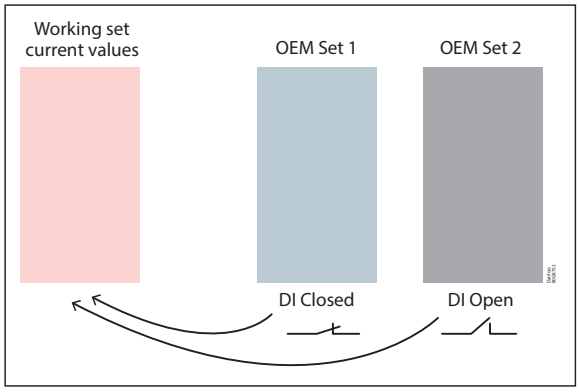
Parameter	Value	Description
A36 Alarm sensor S4%	0 – 100%	Weight of S4 sensor in alarm air temp.
A13 High alarm limit	-60 – 50 °C	High alarm limit
A14 Low alarm limit	-60 – 50 °C	Low alarm limit
A03 Alarm delay	0 – 240 min	Alarm delay at normal control
A12 Alarm delay pull down	0 – 240 min	Alarm delay at pulldown conditions
u57 Alarm air temp.	°C	Readout of weighted alarm temperature
y10 High alarm limit	°C	Readout of actual high alarm limit
Y11 Low alarm limit	°C	Readout of actual low alarm limit

Switch operation mode – Plugin for MT and LT

Some refrigerated plug-in cabinets are designed so that they can switch between operation modes for respectively medium temperature food and low temperature food. These types of cabinets can usually be moved around in the store and placed at the most convenient place to present food for sale. When loading the cabinet with a food type category, the user will set the operation mode of the cabinet via a key switch placed on the cabinet. When switching operation mode, the controller will adapt the controller configuration accordingly to tune the control to the two different operation modes e.g. temperature set point, alarm limits, compressor operation modes, variable compressor PI control, defrost schedules etc.

The controller offers the option to store two OEM operating sets of parameters for respectively MT and LT operation. The operating sets can be programmed via the desktop application "KoolProg" and can be adapted in the field by copying the actual working set of parameters to one of the two OEM operating sets.

Figure: When an OEM working set is selected by a digital input, the OEM parameter values will be transferred to the actual working set, adapting the control to respectively LT and MT operation



The OEM operating set can be selected via the following options:

- Selecting the OEM operating set via the function "oPS" in the direct-action menu of the display (placed in info menu)
- Switching OEM operating set via a digital input signal

If a digital input is used for changing OEM operating set, the direct-action function cannot be used.

Be aware, when an OEM operating set is selected, the parameter values of this OEM operating set will be transferred to the actual working set of the controller and thereby overwrite the values in the working set.

The parameter values of the actual working set can be transferred back to one of the OEM operating sets via a parameter, allowing to adapt the OEM operating set values in the field.

Parameter	Value	Description
OPS - Switch operation mode	0: None 1: OEM set 1 2: OEM set 2	Direct action function in display "Info" menu
q58 Manage operation modes	0: None 1: Copy to OEM set 1 2: Copy to OEM set 2 3: Erase OEM sets	Copy actual working set to an OEM set
ua1 Operation mode	0: None 1: OEM set 1 2: OEM set 2	Readout of OEM set in use

Compressor control

ON/OFF control of a single compressor

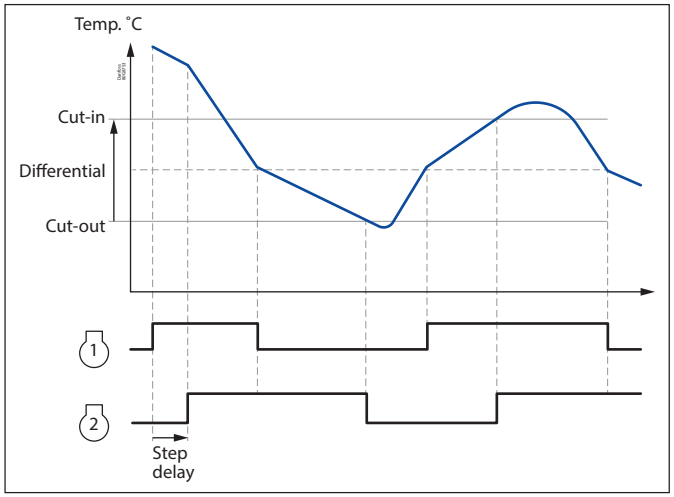
When only one compressor relay is configured, the compressor is started when the thermostat air temperature reaches the thermostat cut-in value and stopped when the temperature reaches the cut-out value.

ON/OFF control of two compressors - single refrigeration circuit

Two compressors can be controlled cyclic or sequentially. At cyclic control, the two compressors must be of the same size, while in sequential control compressor 1 can be larger than compressor 2.

Cyclic control

Figure: Capacity control of two compressors on same refrigeration circuit



When the controller demands refrigeration, it will first cut in the compressor with the shortest operating time. After the time delay, the second compressor will be cut in. When the temperature has dropped to "the middle of the differential", the compressor with the longest operation time will be cut out. The running compressor will continue until the temperature has reached the cut-out value. Then it will cut out. When the temperature again reaches the middle of the differential, a compressor will again be started. If one compressor cannot maintain the temperature within the differential, the second compressor will also be started. If one of the compressors has run on its own for two hours, the compressors will be changed over so that operational time is balanced. The two compressors must be of a type that can start up against a high pressure.

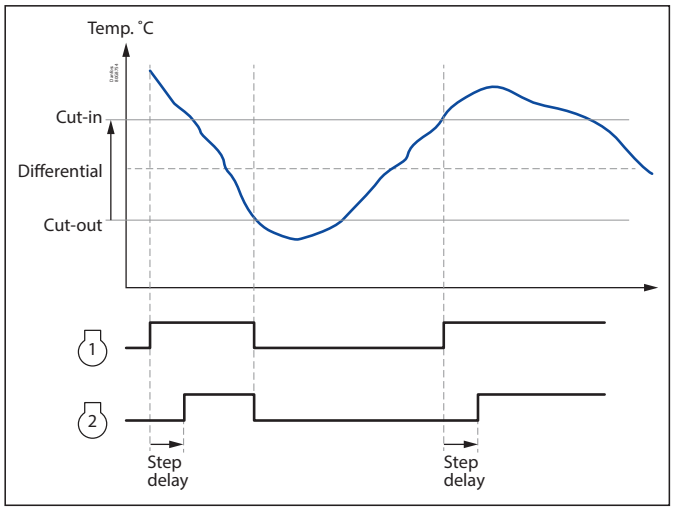
Sequential control

Compressor steps are controlled in the same manner as described for cyclic control, but compressor step 1 will always be started first and cut out as the last one. No time equalization is available in sequential control mode.

ON/OFF control of two compressors – Independent refrigeration circuits

When a case has two independent refrigeration circuits, each having a single on/off compressor, both compressors will be started at the same time, with a short time delay between them and they will stop at the same time.

Figure: Control of two on/off compressors in two independent refrigeration circuits



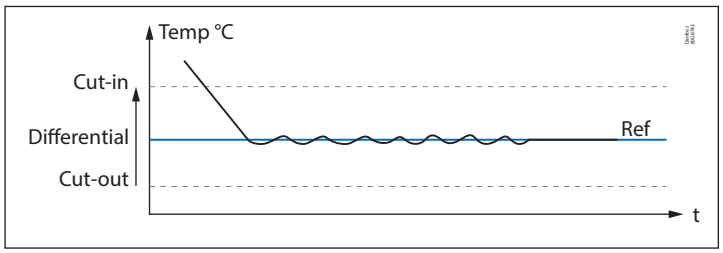
Parameter	Value	Description
c08 Step control mode	1: Sequential 2: Cyclic 3: Dual circuits	For one refrigeration circuit, select either cyclic (FIFO) or sequential (FILO) control When having two independent refrigeration circuits, select dual circuits.

Variable speed compressor

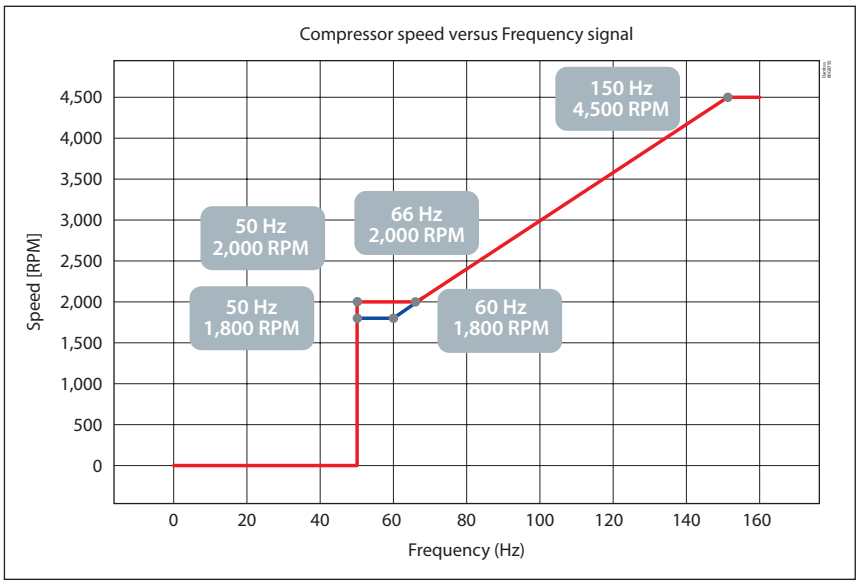
Speed control

Variable speed control is enabled when the analogue output AO1 is configured for a variable speed compressor. The speed of the VSC will be controlled via a frequency signal on AO1. The speed of the VSC compressor will be controlled, so that the air temperature is kept at the mid-point between the cut-out and cut-in value.
Variable speed control can only be used for a single compressor application.

Figure: Temperature control with VSC



The figure below shows a typical relation between the frequency control signal and the number of revolutions per minute for a VSC.



In this example, the compressor operating range can be defined as:

- Start speed: 66 Hz
- Minimum speed: 50 Hz
- Maximum speed: 150 Hz
- Stop speed: < 50 Hz

Please notice: In the example above, the VSC compressor can be stopped by giving a low frequency control signal in the range below 50 Hz and this means that a digital output for start/stop of the compressor can be saved and thereby used for another function.

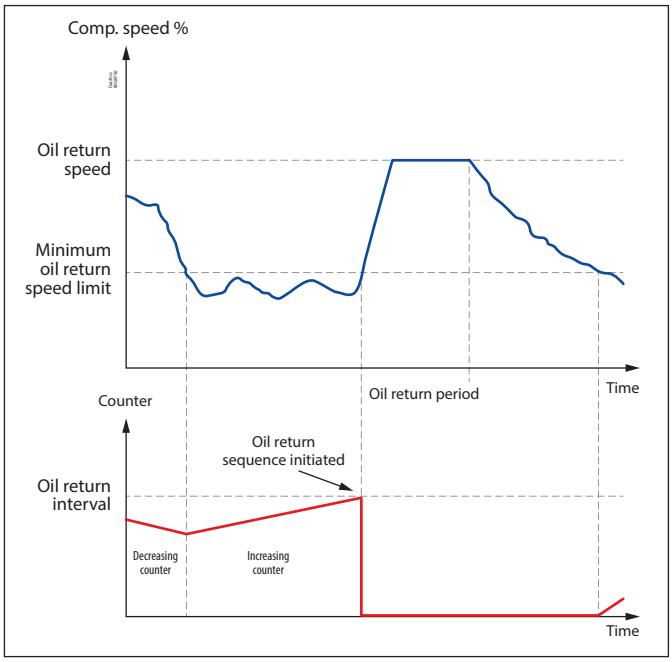
The capacity control will run as follows: When the thermostat air temperature increases above the thermostat cut-in limit, the frequency signal will jump to 66 Hz and the compressor will run at this speed for 10 seconds, before the variable speed control takes over. From here on, the frequency will vary with the requested capacity of the compressor and ensure a precise temperature control in the cabinet. If the requested capacity reaches the defined minimum speed limit of 50%, the compressor will continue to run at this speed until the air temperature decreases below the cut-out limit for a set time delay. At this point, the frequency signal will drop to the defined stop frequency and the compressor will be cut-out via the relay signal (if configured).

Parameter	Value	Description
c49 Stop speed	0 – c46 Hz	Frequency signal for switching OFF compressor
c46 Minimum speed	c49 – c47 Hz	Minimum compressor speed
c47 Start speed	c46 – c48 Hz	Start speed of compressor
c48 Max speed	c47 – 200 Hz	Maximum compressor speed
c82 Speed Kp	3.0 – 30.0	Amplification factor for PI control when close to setpoint
c98 Max. Kp factor	5.0 – 50.0	Amplification factor for PI control when far from setpoint
c83 Speed Tn	30 – 900 s	Integration time for PI controller
c96 Max. speed slope	0.1 – 5 (%/s)	Maximum allowed change in speed per second (%/s)
c97 Comp. defrost speed	0 – 100%	The compressor will run with the defined speed during the hot gas defrost

Oil return management

If the variable speed compressor is running with a low speed for a long period, there is a risk that oil will be trapped in the system and will not return to the compressor. The oil return management feature will prevent this from happening. If the variable speed compressor has been running below a set oil return speed for a set period of time, the compressor will increase the speed for a defined period of time and thereby ensure that oil is returned to the compressor due to the higher refrigerant velocity in the pipes.

Figure: Oil return management for variable speed compressor

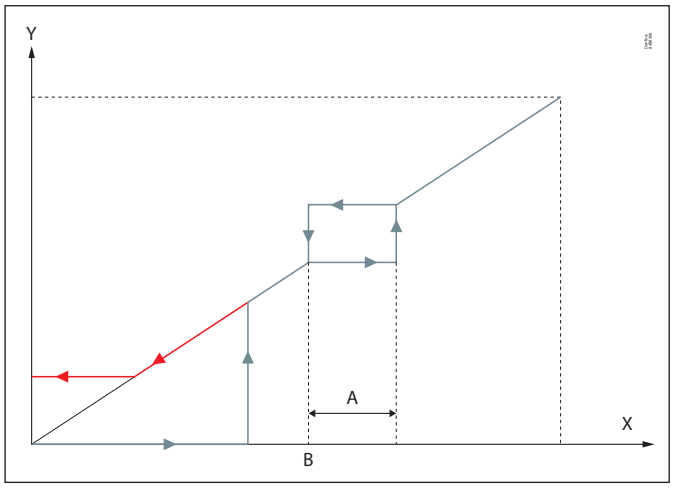


Parameter	Value	Description
P79 Oil return speed	P77 – 100%	Speed at oil return cycle – in percentage of max speed
P80 Oil return time period	10 – 600 s	Duration of oil return cycle
P77 Oil return speed limit	0 – 100%	When the speed is below, the oil return counter increases When the speed is above, the oil return counter decreases
P78 Oil return interval	5 – 720 min	When oil return counter reaches this value, an oil return cycle is initiated

Resonance band

Speed control can cause mechanical resonance vibrations to occur in the system and thereby create irritating noise. To prevent this, the speed control features an option of eliminating the speed range where the mechanical vibrations are present. The speed resonance range is defined as a minimum resonance limit and a resonance zone. Within the defined resonance range, the speed will be kept constant - please refer to the curve below.

Figure: Resonance curve



X	Requested capacity
Y	AO1 voltage
A	P40 Resonance band
B	P39 Resonance band start

Parameter	Value	Description
P39 Resonance band start	0 – 100 %	Speed at start of resonance band - set in percentage of max speed
P40 Resonance band	0 – 15 %	Width of resonance band

Compressor anti cycle timers

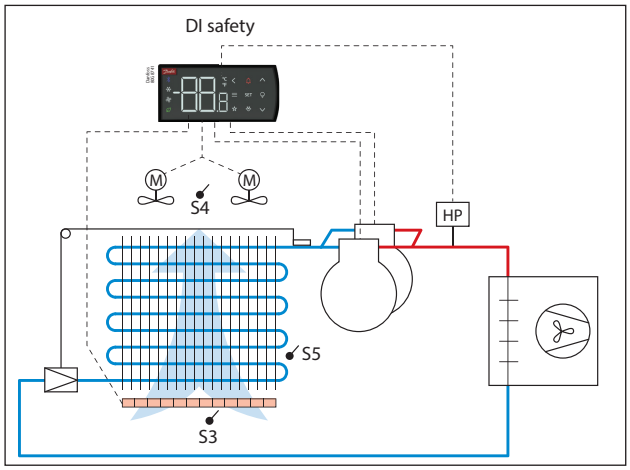
The compressor anti cycle timer function applies to each compressor in a given compressor configuration.
If a compressor is started, it has to run for a set minimum ON time.
If a compressor is stopped, it has to be at standstill for a set minimum OFF time.

Parameter	Value	Description
c01 Min ON time	0 – 30 min	Minimum time a compressor shall run once started
c02 Min OFF time	0 – 30 min	Minimum time a compressor shall stand still once stopped

Compressor safety monitoring

The safety chain of the compressor can be monitored via a digital input signal. If the safety chain is broken e.g. HP switch open, a compressor safety alarm will be generated, and the compressor will be stopped. Once the problem has been remedied, the compressor will be started, provided that the min. OFF timer for the compressor has expired. For the dual compressor application, only one alarm will be generated as it is not possible to identify which compressor that has been cut-out on safety. For the dual circuit application, a digital input can be defined for each compressor circuit.

Figure: Safety monitoring of compressor via digital input



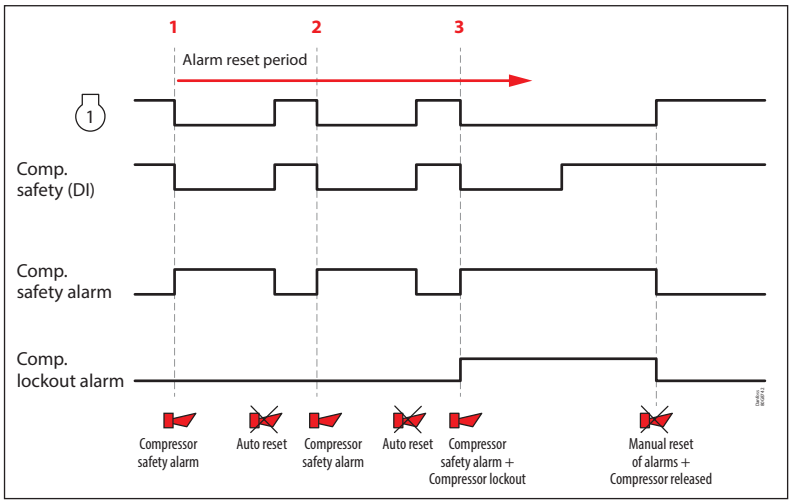
Semi-automatic safety protection and lockout of compressor

Normally alarms are reset automatically when an alarm condition is cleared. However, if the semi-automatic reset option is enabled for the compressor safety monitoring via DI or the condenser block monitoring, then the associated alarm will be reset automatic when the alarm condition is "False" (DI input is closed or condenser temp dropped) unless it is raised more than a max defined number of times within a defined period of time, whereby the compressors are locked out and prevented from starting. At this point in time, also a "Compressor lockout" alarm is generated, and a clearance of the safety alarm and the lockout alarm shall require a manual reset action.

The maximum no. of alarms that are allowed to be raised before a manual reset is required can be defined. Please refer to example below where the max no. of compressor safety alarms is defined as 2 within a set alarm reset period. When the alarm is raised the third time a compressor lockout alarm is generated, and a manual reset is required to reset the safety alarm and the lockout alarm and release the compressor for a new start up.

Parameter	Value	Description
P92 Safety action	0: None 1: Lights off	Select the action taken if repeated condenser block alarms result in lockout of compressors
P93 Safety event period	0 – 120 min	Time period for counting maximum number of allowed safety events for compressor safety and condenser block safety
P94 Max safety events	0 – 20	The maximum of repeated compressor safety and condenser block safety events before the compressors are lockout
--- Alarm reset	ON/OFF	Network parameter for resetting safety lockout alarm

Figure: Semi-automatic reset and lockout of compressor operation



The safety lockout alarm can be reset in one of the following ways:

- Putting main switch in OFF position
- Powering down the controller
- Via network parameter
- By a long press on display alarm button while in alarm menu

Defrost control

Defrost start

All the mentioned defrost start methods can be used in parallel – if just one of them is activated, a defrost will be started.

Manual start

An extra defrost can be activated from the defrost button on the display via the app, or via a parameter setting.

Network

The defrost start signal is received from a system manager via data communication.

Parameter	Value	Description
Start defrost	ON/OFF	Command for starting a defrost
Stop defrost	ON/OFF	Command for stopping a defrost

Display button

A long press on defrost button will initiate a defrost or stop an on-going defrost.

Interval

Defrost is started at fixed time intervals like e.g. every eighth hour. An interval must ALWAYS be set to a "higher" value than the period set between two defrost cycles when a schedule or network signal is used.

Parameter	Value	Description
d03 Defrost start interval	0-240 hours	Max time interval between two defrost start
d05 Time staggering power-up	0-240 min	Time delay added to interval time for start of first defrost at power up

Week schedule

Here defrost can be started at fixed times of the day and night. However, max. 6 defrosts per day.

Parameter	Value	Description
t00 Defrost schedule	No/Yes	Enable defrost schedule
t01 Def. start 1 - Hours	0 – 23 hours	Time for start of first defrost - hours
t11 Def. start 1 - Minutes	0 – 59 min	Time for start of first defrost - minutes
----		
t06 Def. start 6 - Hours	0 – 23 hours	Time for start of sixth defrost - hours
t16 Def. start 6 - Minutes	0 – 59 min	Time for start of sixth defrost - minutes

Digital input

Defrost is started with a contact signal on a digital input.

Max. thermostat runtime

When the aggregate thermostat runtime has passed a preset value, a defrost will be initiated.

Parameter	Value	Description
d18 Max. thermostat run time	0 – 240 hours	Accumulated compressor runtime before start of defrost

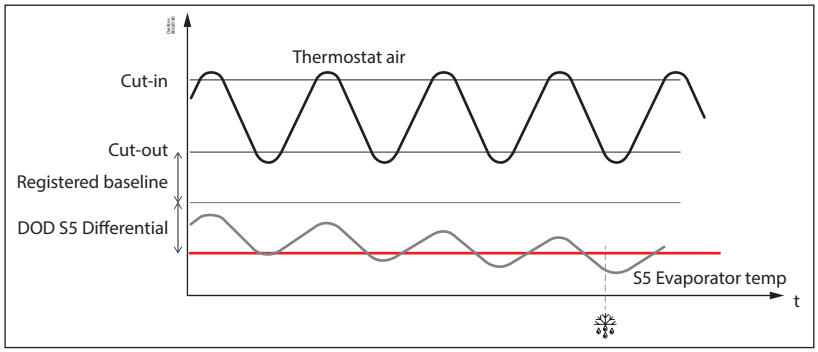
We need to add one more defrost start method - I will provide text and drawing in separate document. The start method is called: Defrost on demand - S5 Evap. temp. drop at icing up of evaporator.

Defrost on demand

The feature is based on the fact that the suction pressure will decrease if the evaporator is icing up. After a defrost the controller will register the temperature level of the S5 evaporating temp. each time the thermostat makes a cut-out – please refer to the drawing below

Over time the evaporator is icing up and the S5 evaporating temperature will drop compared to when the evaporator was clean. The user shall define how much the S5 sensor value is allowed to drop during operation, compared to the baseline value obtained just after a defrost cycle where the evaporator is clean.

If the S5 evaporating temp. is below the set limit 3 times in a row, a defrost is initiated.



Parameter	Value	Description
d19 DOD S5 differential	0 – 20 K	Maximum allowed drop in S5 Evaporating temperature for starting a defrost sequence

Defrost sequence

When a defrost is initiated, the controller will run through the following sequence:

1. **Pump down state**, where the compressor is run to build up hot gas (plugin case) if a hot gas defrost cycle is to be run. For other defrost methods the compressor is not run during pump down state.
2. **Equalization state** only used for hot gas defrost, where the hot gas valve is opened while the compressor is stopped
3. **Defrost state**, where the ice is melted. The duration of an on-going or the last defrost can be read out as well as the average duration of the last 10 defrost states
4. **Hold after defrost state**, where multiple controllers wait for each other (only used at coordinated defrost)
5. **Drip off state**, where remaining water is dripping off evaporator
6. **Fan delay state**, where the fans are stopped and when the remaining water has turned into ice, the fans are restarted.

The duration of the defrost states are set via the following parameters:

Parameter	Value	Description
d01 Defrost method	0: None 1: Air 2: Electrical 3: Hot gas 4: El. pulsing	Select method of defrost
d10 Defrost stop method	0: Time 1: S5 2: S4 3: S5A + S5B	Here you define whether a defrost cycle is to be stopped by time or by a temperature sensor
d02 Defrost stop limit	0 – 50 °C	When the selected defrost stop sensor reaches the set limit, the defrost cycle is terminated
d04 Max. defrost time	0 – 45 min	Max. duration of a defrost cycle
d24 Min. defrost time	0 – 60 min	Min. duration of defrost state
d16 Pump down delay	0 – 60 min	Duration of pump down state
d42 Pressure equalization delay	0 – 30 min	Pressure equalization delay for hot gas. During pressure equalization state the hot gas valve is open to equalize pressure levels in the system
o16 Max. hold time	0 – 360 min	Max. duration of hold state at co-ordinated defrost
d06 Drip off time	0 – 60 min	Here you set the time that is to elapse from a defrost state is terminated and until the compressor is to start again. (The time when water drips off the evaporator).
d07 Fan start delay	0 - 60 min	Here you set the time that is to elapse from compressor start after a defrost and until the fan may start again. (The time when remaining water is transformed into ice on the evaporator).

Defrost method

The following defrost methods can be selected:

- None
- Air cycle defrost
- Electrical defrost
- Simple hot gas defrost
- Electrical defrost – pulsing heaters

The duration of the defrost states are set via the following parameters:

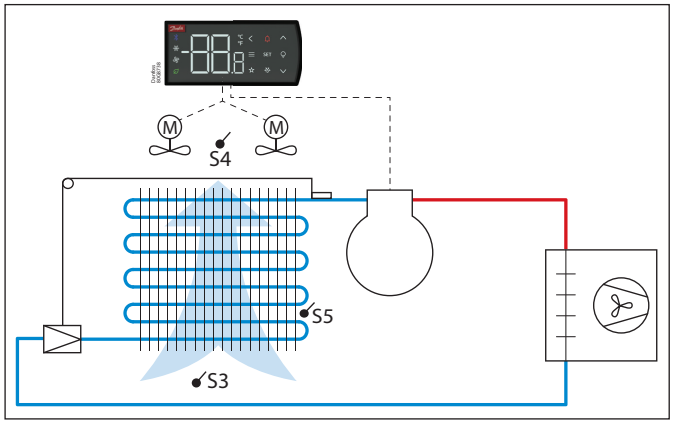
Parameter	Value	Description
d01 Defrost method	0: None 1: Air 2: Electrical 3: Hot gas 4: El. pulsing	Select method of defrost

When the defrost method has been selected for "None" the whole defrost control is disabled and it will not be possible to start a defrost sequence.

Air cycle defrost:

At air cycle defrost the evaporator is defrosted by stopping the compressor and recycling the cabinet air through the evaporator. The defrost heater output is not used.

Figure: Air cycle or natural defrost by circulating air



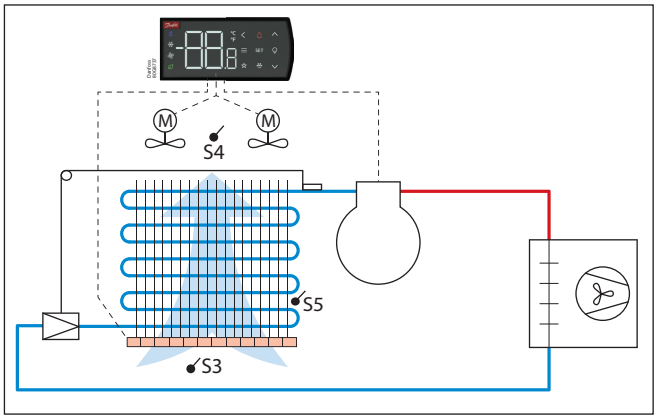
Output	Pump down state	Defrost state	Hold after defrost state	Drip delay state	Fan delay state
Compressor 1	OFF	OFF	OFF	OFF	ON
Compressor 2	OFF	OFF	OFF	OFF	ON
Comp. speed	OFF	OFF	OFF	OFF	ON
Defrost	OFF	OFF	OFF	OFF	OFF
Fan[1]	ON	ON	ON	ON	OFF

[1] The fan status depends upon selected fan control during defrost (Here fan control = ON).

Electrical defrost

At electrical defrost, heaters are placed in front of the evaporator to increase the air temperature and thereby defrost the evaporator. The fans need to run during the defrost state to force the air through the heaters and subsequently through the evaporator.

Figure: Electrical defrost with heaters in front of evaporator



The defrost sequence will be as shown in the table below:

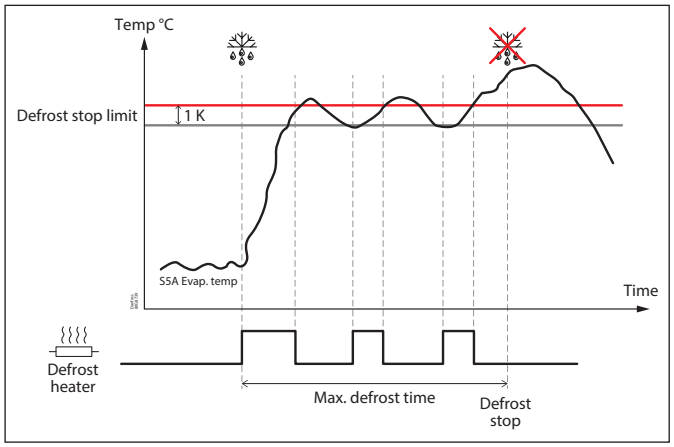
Output	Pump down state	Defrost state	Hold after defrost state	Drip delay state	Fan delay state
Compressor 1	OFF	OFF	OFF	OFF	ON
Compressor 2	OFF	OFF	OFF	OFF	ON
Comp. speed	OFF	OFF	OFF	OFF	ON
Defrost	OFF	ON	OFF	OFF	OFF
Fan[1]	ON	ON	OFF	OFF	OFF

[1] The fan status depends upon selected fan control during defrost (Here fan control = OFF at drip.

Electrical defrost with pulsing heaters

During the defrost state, the electrical heaters will be kept ON, until the defrost stop sensor reaches the set defrost stop limit. At this point in time the defrost heaters will be switched OFF. If the temperature of the selected defrost stop sensor decreases 1K below the set defrost stop limit, the defrost heaters will be switched ON again and kept ON until the defrost stop sensor reaches the defrost stop limit once again whereby the heaters are switched OFF. This pattern is repeated until the max defrost time has expired whereby the active defrost state is terminated and the defrost sequence continues with the next defrost state - please refer to the figure below.

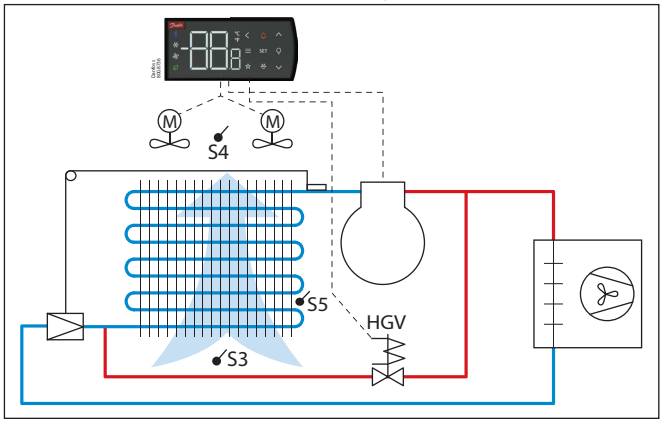
Figure: Defrost state with pulsing of electrical heaters



Simple hot gas defrost

Simple hot gas defrost is used in plug in units, where the compressor must run during the defrost state to produce hot gas for the defrosting of the evaporator. The defrost output is used to control a hot gas by-pass valve. As the evaporator is defrosted from within the refrigerant circuit, the fans are usually not used during the defrosting.

Figure: Simple hot gas defrost with bypass valve



The defrost sequence will be as shown in the table below:

Output	Pump down state	Pressure equalization state	Defrost state	Hold after defrost state	Drip delay state	Fan delay state
Compressor 1	ON	OFF	ON	OFF	OFF	ON
Compressor 2	ON	OFF	ON	OFF	OFF	ON
Comp. speed	Defrost speed	OFF	Defrost speed	OFF	OFF	ON
HG valve	OFF	ON	ON	ON/OFF*1	ON/OFF(1)	OFF
Fan(2)	ON/OFF(2)	OFF	OFF	OFF	OFF	OFF
Cond. fan	Normal/OFF(3)	Normal/OFF	Normal/OFF	Normal	Normal	Normal

(1) State of HG valve can be selected, so that a drip tray heater can be used on the same output.
(2) The fan status depends upon selected fan control during defrost (Here fan control = OFF).
(3) State of condenser fan can be defined – Either normal control or OFF to build up more hot gas pressure.

Parameter	Value	Description
d43 Hot gas valve at drip	ON/OFF	Select whether hot gas valve shall be ON or OFF during drip state. This provides the option of having a drain heater connected to the hot gas valve output.
d45 Cond. fan at defrost	OFF/Normal control	Select whether the condenser fan shall run normal control or stop during a hot gas defrost

Defrost stop

The defrost state in the defrost sequence can be stopped by one of the following ways:

- Defrost stop on time
- Defrost stop on S5A temp.
- Defrost stop on S4 temp.
- Defrost stop on S5A temp and S5B temp

When the selected defrost stop sensor reaches the set defrost stop limit, the defrost is terminated. If the defrost stop sensor does not reach the set defrost stop limit within the set max. defrost time, the defrost will be terminated on time.

Parameter	Value	Description
d10 Defrost stop method	0: Time 1: S5 2: S4 3: S5A + S5B	Here you define whether a defrost cycle is to be stopped by time or by a temperature sensor
d02 Defrost stop limit	0 – 50 °C	When the selected defrost stop sensor reaches the set limit, the defrost cycle is terminated

When using S5A and S5B sensors for defrost stop, the control logic depends upon the number of defined defrost outputs and whether it is a single circuit or dual circuit application. The logic is as follows:

No output defined
Defrost state is terminated when S5A and S5B both have reached the set defrost stop limit.

One defrost output
Defrost output goes OFF, when S5A and S5B both have reached the defrost stop limit.

At hot gas defrost with two refrigeration circuits, the compressors are stopped individually when the associated S5 sensor reaches the defrost stop limit.

Two defrost outputs
The individual defrost output goes OFF, when the associated S5 sensor reaches the defrost stop limit.

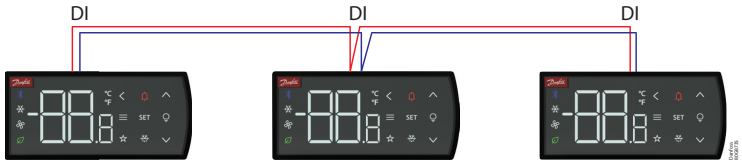
At hot gas defrost with two refrigeration circuits, the compressors are stopped individually when the associated S5 sensor reaches the defrost stop limit.

Co-ordinated defrost

Co-ordinated defrost can be arranged in two ways

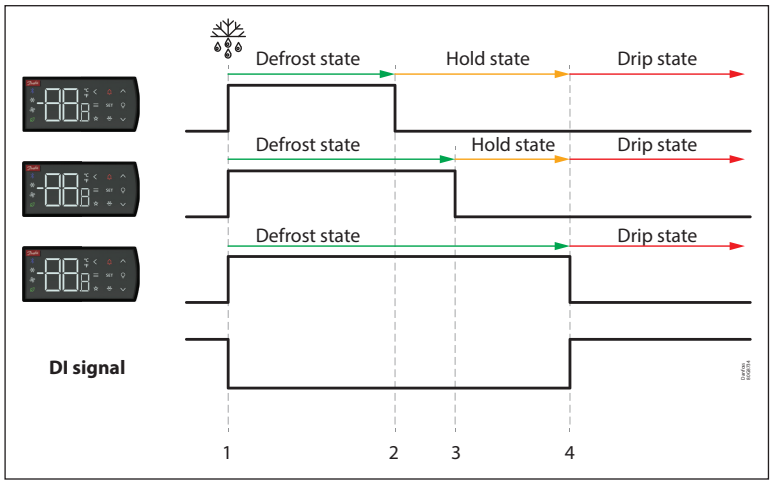
Wired co-ordinated defrost
The digital input DI2 must be configured for coordinated defrost and wiring must be connected between the relevant controllers.

Figure: Defrost co-ordination via DI2 inputs



When one controller starts a defrost, all the other controllers will follow suit and likewise start a defrost. After the defrost, the individual controllers will move into waiting position. When the last controller ends defrosting, the defrost sequence will continue with drip delay.

Figure: Timing diagram for co-ordinated defrost



Co-ordinated defrost via network

Here the network system manager handles the coordination. The controllers are gathered in defrosting groups and the system manager ensures that defrosting is started in the group according to a weekly schedule.

When a controller has completed defrosting, it sends a message to the system manager and then goes into a waiting position. When the last controller ends defrosting the defrost sequence will continue with drip delay.

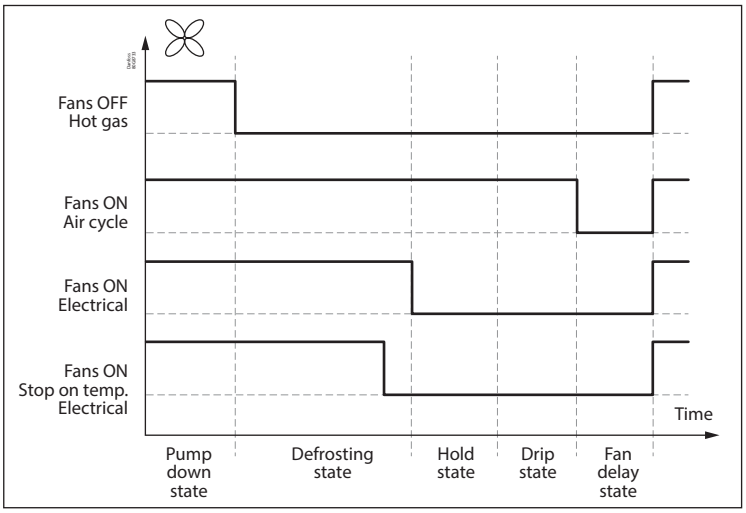
Parameter	Value	Description
o16 Max. hold time	0 – 360 min	Max. waiting time at coordinated defrost.

Fan control during defrost

During the defrost sequence, the evaporator fans can be controlled in one of the following ways:

- The fan is OFF during the entire defrost sequence
- The fan is ON during the entire defrost sequence except during fan delay state
- The fan is ON during defrost state and is OFF during the rest of the defrost sequence
- Like fan is ON during defrost sequence, however the fans are stopped if the selected defrost stop sensor exceeds a set fan stop limit

Figure: Fan control options during defrost



Parameter	Value	Description
d09 Fan control during defrost	0: OFF 1: ON 2: OFF at drip 3: OFF at temp.	Here you can set how the fan is to operate during defrost.

Fan delay state

When entering the fan delay state cooling is resumed and the fans are stopped (if not already OFF), so that the remaining water on the evaporator surface can be transformed into ice.

The fans will be started based on either of the two conditions:

1. If the S5 evaporator sensor temperature has decreased below a set temperature limit. If two defrost stop sensors are used, the highest value of the two S5 sensors shall be below the set temperature limit.
2. If the maximum fan delay time expires, the fans will be started irrespectively whether the S5 sensor has reached the set minimum temperature limit for starting the fans.

Rail heat control during defrost

During the defrost sequence, the rail heat control can be managed in the following ways:
- Rail heat is stopped to minimize power consumption during defrost sequence
- Rail heat goes to 100% power to eliminate water to condense on glass parts
- Rail heat continue normal control

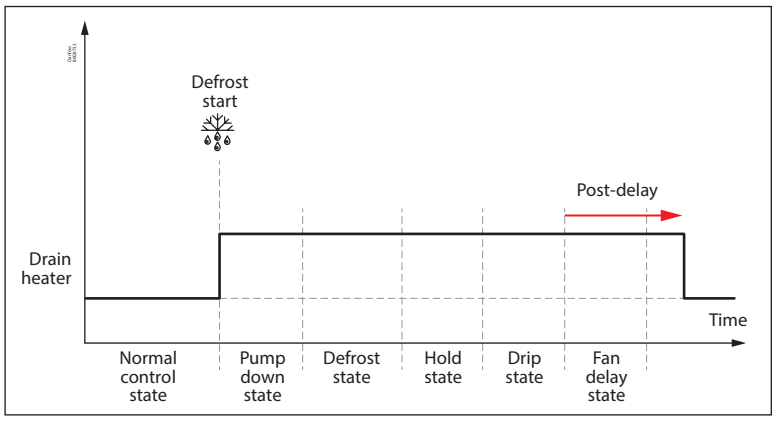
Parameter	Value	Description
d27 Rail heat during defrost	0: OFF 1: ON 2: Normal ctrl	Here you can set how the rail heat is to operate during defrost.

Drain heater control

The drain heater is used to ensure that the water drainage system is kept ice free while defrosting the evaporator. The function is enabled if one of the DO outputs is configured for the Drain heater function.

When a defrost sequence is started, the Drain heater output is set ON. The drain heater output will stay ON during the whole defrost sequence plus for a set post delay counted from the ending of the drip state.

Figure: Control of drain heater during a defrost sequence



Parameter	Value	Description
d20 Drip tray heater delay	0 – 240 min	Set the post delay time for stop of drain heater

Fan control

Fan pulsing

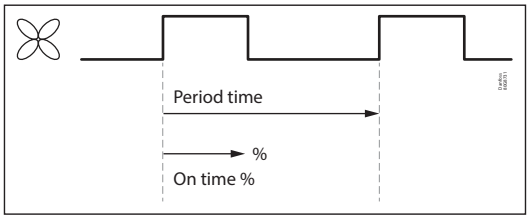
Whenever cooling is performed the evaporator fans will have to run to ensure a good heat exchange between the refrigerant in the evaporator and the cabinet air. However, if the refrigerated cabinet is covered by a night curtain eliminating intake of fresh air, the fans can be pulsed in the thermostat cut-out periods where no cooling takes place. As cold rooms by definition is closed spaces, then the fans can be pulsed during the thermostat cut-out periods around the clock.

The reason for pulsing the fans and not stopping them completely, is that the air has to be circulated in the cabinet from time to time in order for the air temperature sensors to represent the temperature of the refrigerated produce inside the cabinet/cold room.

The user shall have the following options for pulsing the evaporator fans:
- At nighttime at thermostat cut-out on refrigerated cabinets with night covers/curtains
- At thermostat cut-out around the clock on refrigerated cabinets with permanent night covers and for cold rooms

The user shall be able to define the period time of a pulse cycle and the percentage of ON time of the fan within the defined pulse cycle - please refer to drawing below.

Figure: Pulsing control of fans



Parameter	Value	Description
F05 Fan pulsing mode	0: Nu pulsing 1: Always pulsing 2: Pulsing night	Select when to pulse the fans at thermostat cut-out
F06 Fan period time	1 – 120 min	Period time for pulsing of fan
F07 Fan ON cycle	0 – 100%	The ON time is set as a percentage of the period time

Fan stop at loss of refrigeration

If the refrigeration in a breakdown situation stops, the temperature in the cold room may rise quickly because of the emission of heat from large fans. To prevent this situation, the controller can stop the fans if the evaporator temperature S5 exceeds a set limit value. The fans will start running again when the S5 temperature has dropped 2K below the set limit. (The function can also be used as a type of MOP function. Here the load on the compressors is limited until the S5 temperature has fallen below the configured value).

Parameter	Value	Description
F04 Fan stop high S5 temp.	-60 – 50 °C	If the evaporator sensor S5 registers a higher temperature than the one set here, the fans will be stopped. Function is enabled by setting the value above the minimum setting range.

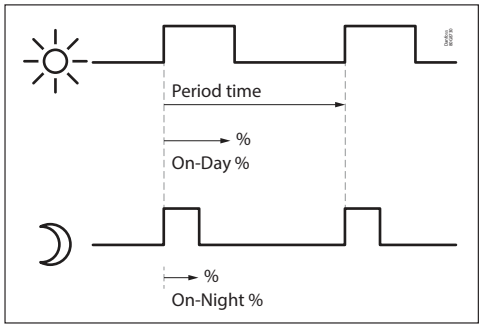
Rail heat control

Rail heaters are used on refrigerated cabinets to prevent moisture condensation on glass and rails. It is possible to pulse-control the power to the rail heat to save energy. Pulse control can either be timer controlled according to variations in day/night loads or due to the actual dew point.

Timer controlled

Here the rail heater is controlled according to a duty cycle pattern, where the heaters are set ON for a set percentage of the period time for respectively day and night operation. In this way the user can adapt the rail heaters power consumption to the actual load for day and night operation. The principle of the duty cycle control is shown in the figure below.

Figure: Time controlled pulsing of rail heat for day respectively night operation



Parameter	Value	Description
o85 Rail heat control mode	0: Always ON 1: Time control 2: Dew point	Select how the rail heaters are to be controlled
o43 Rail heat period time	6 – 60 minutes	Period time for pulsing of fan
o41 Rail heat ON cycle day	0 – 100%	ON time at day operation as a percentage of the period time
O42 Rail heat ON cycle night	0 – 100%	ON time at night operation as a percentage of the period time

Dew point controlled

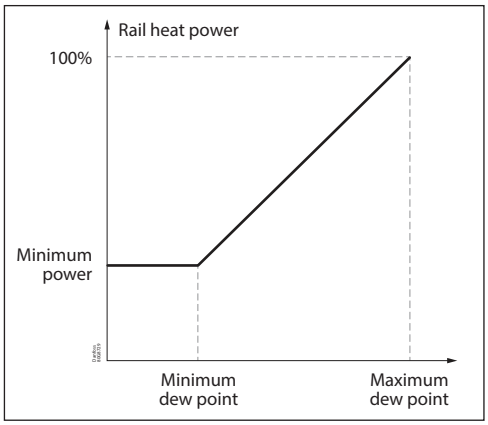
In order to use this function, a system manager of the type AK-SM is required which can measure ambient temperature and humidity to calculate dew point and distribute to the appliance controllers.

For this the rail heat's ON period is controlled according to the distributed dewpoint. Two dew point values must be set in the rail heat control:

- The maximum dew point at which the power must be max. i.e. 100% (o87)
- The minimum dew point at which the power must be at the set minimum value (o86)

At a dewpoint which is equal to or lower than the value in o86, the effect will be the value indicated in o88. In the area between the two dew point values, the controller will manage the power to be supplied to the rail heat.

Figure: Rail heat control according to measured dew point



Parameter	Value	Description
o88 Rail heat min. ON cycle	0 – 100%	The minimum power to the rail heaters
o86 Dewpoint min. limit	-10 – o87 °C	Minimum dew point, where power is at minimum level
o87 Dewpoint max. limit	o86 – 50 °C	Maximum dew point, where power is at 100%

Light control

The function can be used for controlling the light in a refrigeration appliance or in a cold room. It can also be used for controlling a motorized night blind. The light function can be defined in several ways.

1. The light is controlled via the day/night function. A digital input setup for light control can switch light ON, if the light is switched off during night
2. The light is controlled by a system manager via the parameter o39. A digital input setup for light control can switch light ON, if the light is switched off by the system manager.
3. Light is controlled via the door switch. Light is switched ON when door is opened and switched OFF 2 minutes after the door has been closed.
4. Like option 2, but here the light is switched ON automatically if the communication to the system manager has been lost for 15 minutes
5. Light is only controlled via a digital input setup for light control

The light load must be connected to the NC terminals on the relay. This ensures that the light remains ON in the appliance if power to the controller should fail. A setting defines how light is controlled when regulation is stopped via r12 Main switch = OFF (see o98). The light is switched off when the appliance cleaning function is activated.

Parameter	Value	Description
u63 Light	ON/OFF	Status of Light
o38 Light control mode	1: Day/night 2: Network 3: Door 4: Network fallback 5: DI input	Select source for light control
o98 Light at Main switch OFF	ON/OFF	Set status of light when main switch is set OFF

Condenser

Safety monitoring

The feature is enabled when a condensing temperature sensor Sc has been configured.

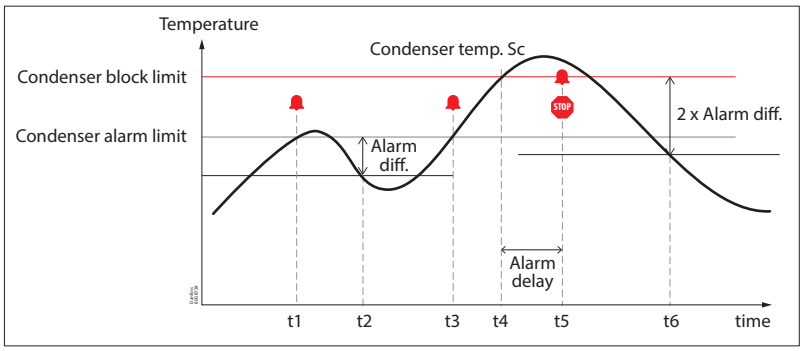
If the condenser temperature is exceeding the set condenser alarm limit a “Condenser high temp” alarm is generated and if possible, the running compressor capacity is reduced to limit the heat load on the condenser and thereby keep the cabinet running. The action taken depend upon the compressor configuration:

- For a single ON/OFF compressor, the compressor will be allowed to run (Capacity cannot be reduced)
- For a single circuit with 2 compressors, the second compressor is stopped
- For a variable speed compressor, the compressor max capacity will be limited to the 0,75 x calculated emergency speed
- For a dual circuit, no action is taken as we do not know which circuit the condenser belongs to

If the condenser temperature is continuing to raise and exceeds the set condenser block limit for a set time delay, a “Condenser block” alarm is generated and for single circuit any running compressor(s) is stopped and is not allowed to start again. For dual circuit, the compressors are not stopped.

The alarm shall be reset, and the compressor(s) is allowed to start again when the condenser temperature Sc has dropped with 2 times the set temperature alarm differential - please refer to the drawing above.

Figure: Condenser safety monitoring



The condenser block alarm has the same semi-automatic reset option and the same optional alarm action for switching off the light as the compressor safety monitoring (see paragraph regarding compressor safety monitoring).

If the max number of "Condenser block alarms" is exceeding the set max number of alarms limit within the set alarm period, then the condenser block alarm shall result in a full stop of the compressors and a manual alarm reset will be required to enable the compressors to start.

Parameter	Value	Description
U09 Sc Condenser temp.	°C	Temperature at Sc condenser sensor
A37 Cond. alarm limit	20 – 120 °C	Alarm limit for Sc condenser temperature
A54 Cond. block limit	20 – 140 °C	Stop limit for Sc condenser temperature
A55 Cond. alarm delay	0 – 60 min	Alarm delay for condenser block alarm
A78 Cond. alarm differential	1 – 30 °C	Temperature differential for condenser alarms

Condenser fan control

This feature is enabled if a digital output has been configured for condenser fan control and an analogue input has been configured for condenser sensor Sc.

If the measured Sc condenser temperature increases above the set cut in limit, the condenser fan is started, and if the temperature decreases with a set differential, the condenser fan is stopped again.

Parameter	Value	Description
U15 Condenser fan	ON/OFF	Status of condenser fan
F24 Cond. fan cut-in	10 – 110 °C	Temperature limit for start of condenser fan
F25 Cond. fan diff.	1 – 20 K	Temperature differential for stopping condenser fan

Door function

The door contact function can via the digital inputs be defined for two different applications:

Alarm monitoring only:
A digital input must be configured for Door alarm (value 3).

The controller monitors the door contact and delivers an alarm message if the door has been opened for a longer period than the set alarm delay.

Alarm monitoring and stop of refrigeration:
A DI input must be configured for Door function (value 2).

When the door is opened, the refrigeration is stopped, i.e. the injection, the compressor and the fan are stopped and light switches on. If the door remains open for a longer time than the set restart time, refrigeration will be resumed. This will ensure that refrigeration is maintained even if the door is left open or if the door contact should be defective. If the door remains open for a longer period than the set alarm delay, an alarm will also be triggered.

Alarm monitoring and stop of fans:
A DI input must be configured for Door fan stop (value 29).

When the door is opened, only the fans are stopped. If the door remains open for a longer time than the set alarm delay, an alarm is triggered, and the fans will start running again.

Parameter	Value	Description
o02 DI1 Config	2: Door function 3: Door alarm 29: Door fan stop	Select function of DI1
o37 DI2 Config	2: Door function 3: Door alarm 29: Door fan stop	Select function of DI2
A04 Door open alarm delay	0 – 240 min	If the door has been opened for a longer time than the set delay, a door open alarm is raised.
o89 Door restart inj. delay	0 – 240 min	If the door has been opened for a longer time than the set delay, refrigeration is resumed (if door function is used).

Leak detection

An external leak detection alarm signal can be monitored via a digital input and an alarm action can be defined if a leak is detected.

Parameter	Value	Description
o02 DI1 Config	20: Leak alarm	Select function of DI1
o37 DI2 Config	20: Leak alarm	Select function of DI2
o59 Leak alarm action	0: No action 1: Compressor OFF 2: Comp. OFF and all fans run 3: Unit is shut down	Select the alarm action at leak detection

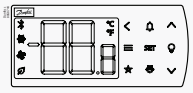
Case cleaning

This function makes it easy for the shop's staff to carry out a cleaning of the appliance according to a standard procedure. Appliance cleaning is activated via a pulse signal – as a rule via a key switch placed on the appliance or via the AK-CC55 Connect mobile app.

Appliance cleaning is carried out via three phases:
1. At the first activation, the refrigeration is stopped, but the fans keep on operating to defrost the evaporators. "Fan" is shown on the display.
2. At the second activation, the fans are also stopped, and the appliance can now be cleaned. "OFF" is shown on the display.
3. At the third activation, refrigeration is recommenced. The display will show the actual appliance temperature, o97 setting.

When appliance cleaning is activated, a cleaning alarm is transmitted to the normal alarm recipient. A later processing of these alarms will document that the appliance has been cleaned as often as planned. There are no temperature alarms during appliance cleaning.

Table: Appliance cleaning function

			
-	+	+	°C
1	÷	+	Fan
2	÷	÷	Off
3	+	+	°C

Parameter	Value	Description
o02 DI1 Config	10: Case clean	Select function of DI1
o37 DI2 Config	10: Case clean	Select function of DI2
o46 Case cleaning mode	0: OFF 1: Fans run 2: Cleaning	Select the case cleaning mode

Case shutdown

A digital input can be defined for case shutdown, which can be used to put a unit out of service when not in use. The function stops control and sets all outputs in standby position. The cooling appliance is stopped like when using the "Main switch", however this happens without an "A45 standby alarm". The function can be enabled by a switch on the DI input or via a setting through data communication.

Parameter	Value	Description
o02 DI1 Config	15: Shutdown	Select function of DI1
o37 DI2 Config	15: Shutdown	Select function of DI2
MC Case shutdown	ON/OFF	Master control parameter for shutdown via system manager

Power up delay

To prevent having a too high power consumption at power up, it is possible to define a power up delay which will delay the cut-in of relay loads. By setting different power up delays in multiple controllers, the total start-up power consumption can be distributed over a longer time span.

Parameter	Value	Description
o01 Delay of outputs at power-up	0 – 600 sec	Set delay for activation of relay loads at power up

Display control

The temperature read-out in the display can be selected and a filter time can be applied to the temperature read-out to prevent too high temperature changes due to door openings. The temperature readout can also be adjusted by an offset.

Parameter	Value	Description
u56 Display readout	°C	Display temperature readout
o97 Display readout	1: Weighted S3/S4 2: S6 Product temp. 3: Thermostat air	Select sensor for display readout
o17 Display air S4%	0-100%	Weight of S4 sensor for display readout
r04 Display readout adjustment	-10 – 10 °C	Offset adjustment of temperature readout
q80 Display filter time	0 – 600 sec	Filter time for display readout. The filter time represents the time it takes for the display readout to reach 66% of its final value

Real-time clock

The controller has a built-in real-time clock which can be used to start defrosts. This clock has a power reserve of four days. If the controller is equipped with data communication, the clock will automatically be updated from a Danfoss system manager.

Parameter	Value	Description
t07 Time hours	0 – 23 Hours	Clock hours
t08 Time minutes	0 – 59 min	Clock minutes
t45 Time date	1 – 31	Clock date
t46 Time month	1 - 12	Clock month
t47 Time year	0 - 100	Clock year – 25 means 2025

Master control overrides

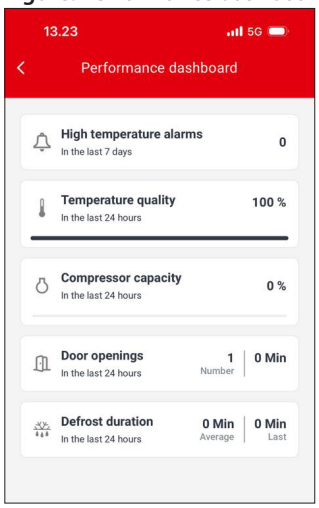
The controller contains a number of override functions which can be used together with Master Control functions in the Danfoss gateway/system manager:

Parameter	Description
MC Ther. toggle	Master control signal used for switching case load ON/OFF depending on the load condition
MC Night setback	Master control signal for changing between day and night time operation
MC Case shutdown	Master control signal used to shut down a case for a time period. During shutdown there will be no alarm monitoring
MC Forced cooling	Master control signal that will provide forced cooling
MC Defrost start	Master control signal for starting a defrost
MC Defrost state	Read out the actual state of the defrost
MC Hold after defrost	Master control signal used for co-ordinated defrost control to hold cabinets from returning to normal refrigeration after a defrost until all cabinets have terminated defrost
MC Stop defrost	Master control signal used to prevent a defrost start in a controller.
MC Light signal	Master control signal for control of light via a data communication signal from the system manager
MC Actual dewpoint	Master control signal sending the actual measured dewpoint from the system manager to the controller over the network.
MC Po load factor	Calculated load factor for the refrigerated appliance. Used for suction pressure optimization
MC Key/Bluetooth lock	Master control signal that will lock down all Bluetooth data communication and optionally also the operation of the display keys (depend upon selection in P89 Display keyboard lock)
MC Load request	Master control signal used to control the load balance between multiple case controllers on the same suction line

Performance monitoring

The controller can monitor certain key performance indicators, telling something about how well the unit is operating. These key performance indicators are available in the AK-CC Connect App.

Figure: Performance dashboard in AK-CC Connect App



Number of high temp. alarms

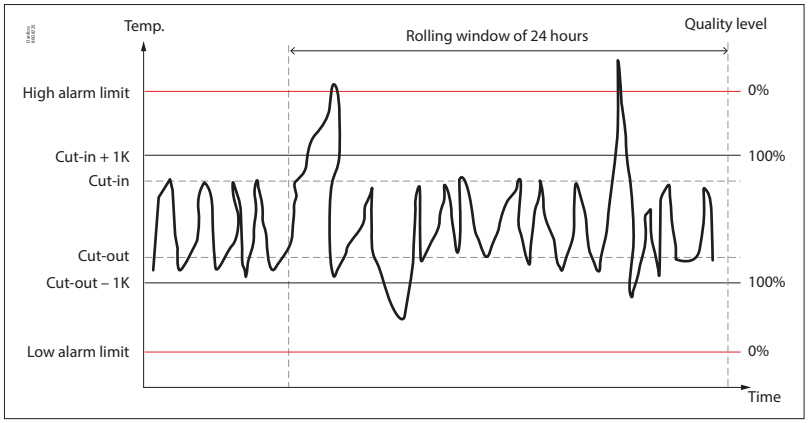
The controller keeps track of the number of high temperature alarm for the last 7 days.

Temperature quality

The temperature quality tells how well the unit is performing temperature wise over a time window of 24 hours. The temperature quality read-out is a weighted value taking the temperature deviation and time into account. If the thermostat air temperature is within the band of "thermostat cutin + a set offset" and "Thermostat cutout – a set offset" the temperature quality will be 100%. The further away the thermostat air temperature is from this band, the lower the temperature quality will be. If the thermostat air temperature reaches the high or low alarm limit, the air quality will be 0%.

Note: the temperature quality will never be 100% as defrost cycles and other interruptions will be counted into the performance. But the value can be used to optimize control.

Figure: Temperature quality as function of deviation from thermostat cut-in and cut-out limits



Parameter	Value	Description
X31 Air temp. performance	0 – 100%	Readout of actual thermostat air quality for the last 24 hours
X32 Temp. offset	0 – 10 K	Offset to thermostat cut-in and cut-out limits, where air quality is 100%

Average compressor capacity

Readout of the average compressor capacity for the last 24 hours. If the average compressor capacity is increasing over time or if it is close to 100%, it should be checked that the case is not overloaded. If not, a service call might be required to optimize the operation of the unit.

Door openings and door open time

Readout of the actual number and accumulated opening time of the door for the last 24 hours.

Defrost duration

Readout of the duration of the last defrost cycle as well as the average duration of the last 10 defrost cycles. These values can be used to evaluate whether the defrost cycles are running at optimal conditions and with a correct stop limit.

Network integration

AK-CC25 is supported by the following Danfoss system managers:

- AK-SM 720/350
- AK-SM 800/800A

When installing the controller into a Danfoss network system, follow the following procedure:

1. Select the application mode (o61)
2. Set the unit address (o03)
3. Perform a network scan from the system manager

AK-CC25 can also be integrated into third party Modbus network systems and then the following network parameters might need to be set:

Parameter	Value	Value	Description
o03	Network address	0 – 240	Network address When used in a network system with a Danfoss system manager AK-SM 800A, the address has to be set in the range 1 – 199.
oa1	Baudrate	1: Auto 2: 9600 baud 3: 19200 baud 4: 38400 baud 5: 115200 baud	Baudrate of data communication. When installed in a Danfoss network system, leave the setting at "Auto"
oa2	Parity and stop bit	0: None 1: Even 2: Odd	None: No parity bit and two stop bits Even: Even parity bit and one stop bit Odd: Odd parity bit and one stop bit

A list of Modbus register numbers can be found at Danfoss.com

Cyber security best practices:

When installing the Modbus network cable, the terminals shall be placed at a physical restricted area only accessible by authorized personnel.

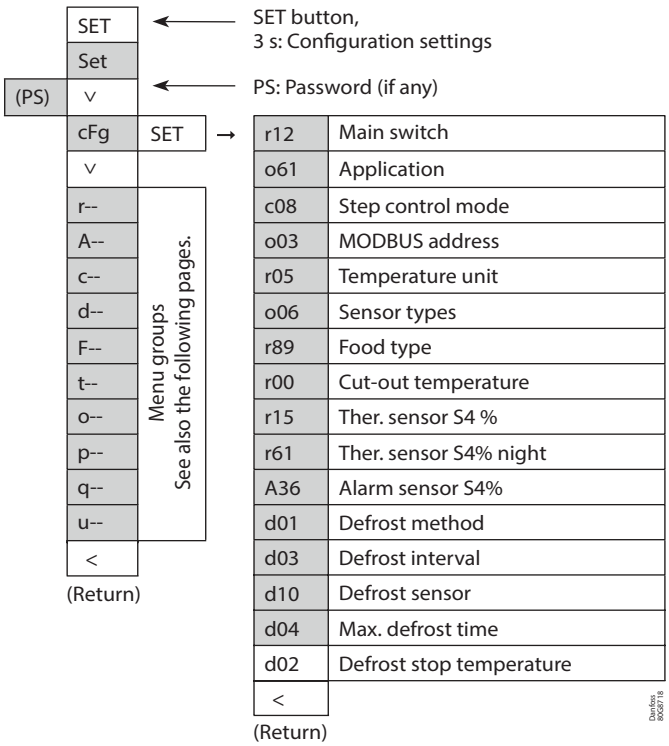
The access level codes o05, o64 and P88 shall be set once the controller is installed

It is recommended to set an access level for the Bluetooth advertising button via parameter q81

It is recommended to lock the display keys, either via the system manager AK-SM800A (best security) or locally via the parameter P89.

Parameters

Parameter grouping at display operation



Display menu

R-W	If the operation is protected by one or more passwords, reading and setting the parameter will be limited to: R or W
R	This setting can be seen with password no. _ or higher (3 is the highest level).
W	This setting can be performed with password no. _ or higher (3 is the highest level).
*	The asterisk indicates in which application from 1-9 the parameter is applicable.

Thermostat

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
r00	Cut-out 1		0-0	*	*	*	*	*	*	*	*	*	r03	r02	2.0 °C
r01	Differential		1-2	*	*	*	*	*	*	*	*	*	0,1 °C	20.0 °C	2.0 °C
r02	Max cut-out limit		0-2	*	*	*	*	*	*	*	*	*	r03	50.0 °C	50.0 °C
r03	Min cut-out limit		0-2	*	*	*	*	*	*	*	*	*	-60.0 °C	r02	-60.0 °C
r04	Display readout adjustment		1-2	*	*	*	*	*	*	*	*	*	-10.0 °C	10.0 °C	0.0 °C
r05	Temperature unit	0=Celsius, 1=Fahrenheit	1-2	*	*	*	*	*	*	*	*	*	0	1	0
r09	S4 Air OFF evap. - Adjustment		1-2	*	*	*	*	*	*	*	*	*	-10.0 °C	10.0 °C	0.0 °C
r10	S3 Air ON evap. - Adjustment		1-2	*	*	*	*	*	*	*	*	*	-10.0 °C	10.0 °C	0.0 °C
r11	S5 Evaporator A - Adjustment		1-2	*	*	*	*	*	*	*	*	*	-10.0 °C	10.0 °C	0.0 °C
r12	Main switch	-1=Manual, 0=Stop, 1=Start	0-2	*	*	*	*	*	*	*	*	*	-1	1	0
r13	Night offset		1-2	*	*	*	*	*	*	*	*	*	-50.0 °C	50.0 °C	0.0 °C
r14	Thermostat mode	2=Modulating, 1=ON/OFF	0-X	*	*	*	*	*	*	*	*	*	1	2	1
r15	Thermostat sensor S4 %		1-2	*	*	*	*	*	*	*	*	*	0 %	100 %	100 %
r16	Melt interval		1-2	*	*	*	*	*	*	*	*	*	0 h	10 h	1 h
r17	Melt period		1-2	*	*	*	*	*	*	*	*	*	0 min	30 min	5 min

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
r59	S6 product temp. - Adjustment		1-2									*	-10.0 °C	10.0 °C	0.0 °C
r61	Thermostat sensor S4 % night		1-2	*	*	*	*	*	*	*	*	*	0 %	100 %	100 %
r62	Air heater neutral zone		1-2									*	0.0 °C	50.0 °C	5.0 °C
r63	Air heater start delay		1-2									*	0 min	240 min	3 min
r89	Food type	0=None, 1=Vegetables, 2=Dairy, 3=Meat and fish, 4=Frozen food, 5=Ice cream	1-2[1]	*	*	*	*	*	*	*	*	*	0	5	0
r98	S4 frost protection		1-2	*	*	*	*	*	*	*	*	*	-60.0 °C	50.0 °C	-60.0 °C
ra1	Temp. pulldown diff		1-2	*	*	*	*	*	*	*	*	*	-50.0 °C	0.0 °C	0.0 °C
ra2	Temp. pulldown time		1-2	*	*	*	*	*	*	*	*	*	0 min	300 min	0 min

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.

Alarm settings

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
A03	Alarm delay		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	30 min
A04	Door open alarm delay		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	60 min
A12	Alarm delay pull down		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	90 min
A13	High alarm limit 1		1-2	*	*	*	*	*	*	*	*	*	-60.0 °C	50.0 °C	8.0 °C
A14	Low alarm limit 1		1-2	*	*	*	*	*	*	*	*	*	-60.0 °C	50.0 °C	-30.0 °C
A27	Alarm delay DI 1		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	30 min
A28	Alarm delay DI 2		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	30 min
A36	Alarm sensor S4%		1-2	*	*	*	*	*	*	*	*	*	0 %	100 %	100 %
A37	Cond. alarm limit		1-2				*					*	20.0 °C	120.0 °C	100.0 °C
A54	Cond. block limit		1-2				*					*	20.0 °C	140.0 °C	120.0 °C
A55	Cond. alarm delay		1-2				*					*	0 min	60 min	5 min
A78	Cond. alarm differential		1-2				*					*	1.0 °C	30.0 °C	10.0 °C

Compressor

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
c01	Min ON time		1-2	*	*	*	*	*	*	*	*	*	0 min	30 min	0 min
c02	Min OFF time		1-2	*	*	*	*	*	*	*	*	*	0 min	30 min	0 min
c05	Delay between comp.		1-2					*	*	*	*	*	0 s	999 s	5 s
c08	Step control mode	1=Sequential, 2=Cyclic, 3=Dual circuits	1-2[1]					*	*	*	*	*	1	3	2
c46	Minimum speed		1-2[1]	*	*	*	*					*	c49	c47	50 Hz
c47	Start speed		1-2	*	*	*	*					*	c46	c48	60 Hz
c48	Max speed		1-2[1]	*	*	*	*					*	c47	200 Hz	150 Hz
c49	Stop speed		1-2	*	*	*	*					*	0 Hz	c46	20 Hz
c82	Speed Kp		1-2	*	*	*	*					*	3,0	30,0	20,0
c83	Speed Tn		1-2	*	*	*	*					*	30 s	900 s	60 s
c96	Max. speed slope		1-2	*	*	*	*					*	0,1	5,0	1,0
c97	Comp. defrost speed		1-2	*	*	*	*					*	0 %	100 %	100 %
c98	Max. Kp factor		1-2	*	*	*	*					*	5,0	50,0	20,0
c99	Comp cut-out delay		1-2	*	*	*	*					*	0 s	600 s	0 s

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.

Defrost

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
d01	Defrost method	0=None, 1=Electrical, 2=Hot gas, 4=Air/Offcycle, 5=Electrical pulsing	1-3[1]	*	*	*	*	*	*	*	*	*	0	5	1
d02	Defrost stop limit		1-2	*	*	*	*	*	*	*	*	*	0.0 °C	50.0 °C	6.0 °C
d03	Defrost start interval		1-2	*	*	*	*	*	*	*	*	*	0 h	240 h	8 h
d04	Max. defrost time		1-2	*	*	*	*	*	*	*	*	*	d24	360 min	45 min
d05	Time staggering power-up		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	0 min
d06	Drip off time		1-2	*	*	*	*	*	*	*	*	*	0 min	60 min	0 min
d07	Fan start delay		1-2	*	*	*	*				*	*	0 min	60 min	0 min
d08	Fan start temperature		1-2	*	*	*	*				*	*	-60.0 °C	10.0 °C	-5.0 °C
d09	Fan control during defrost	0=OFF, 1=ON, 2=OFF at drip, 3=OFF at high temp	1-2	*	*	*	*				*	*	0	3	1
d10	Defrost stop method	0=Time, 1=S5 sensor, 2=S4 sensor, 3=S5A and S5B	1-2	*	*	*	*	*	*	*	*	*	0	3	0
d16	Pump down delay		1-2	*	*	*	*	*	*	*	*	*	0 min	60 min	0 min
d18	Max. thermostat run time		1-2	*	*	*	*	*	*	*	*	*	0 h	240 h	0 h
d19	DOD S5 differential		1-2	*	*	*	*	*	*	*	*	*	0 K	20 K	20 K
d20	Drip tray heater delay		1-2									*	0 min	240 min	0 min
d24	Min. defrost time		1-2	*	*	*	*	*	*	*	*	*	0 min	d04	0 min
d27	Rail heat during defrost	0=OFF, 1=ON, 2=Normal control	1-2			*				*		*	0	2	1
d40	Display delay after defrost		1-2	*	*	*	*	*	*	*	*	*	5 min	240 min	30 min
d41	Fan stop temperature		1-2	*	*	*	*				*	*	-20.0 °C	20.0 °C	0.0 °C
d42	Pressure equalization delay		1-2	*	*	*	*	*	*	*	*	*	0 min	30 min	0 min
d43	Hot gas valve at drip	0=OFF, 1=ON	1-2	*	*	*	*	*	*	*	*	*	0	1	0
d44	Temp. pulldown after defrost	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	0
d45	Cond. fan at defrost	0=OFF, 1=Normal ctrl.	1-2				*					*	0	1	1

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.

Fan control

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
F04	Fan stop high S5 temp.		1-2	*	*	*	*				*	*	-60.0 °C	50.0 °C	50.0 °C
F05	Fan pulsing mode	0=No pulsing, 1=Pulsing cut-out, 2=Pulsing cut-out night	1-2	*	*	*	*				*	*	0	2	0
F06	Fan period time		1-2	*	*	*	*				*	*	1 min	120 min	5 min
F07	Fan ON cycle		1-2	*	*	*	*				*	*	0 %	100 %	100 %
F24	Cond. fan cut-in		1-2				*					*	10.0 °C	110.0 °C	60.0 °C
F25	Cond. fan diff.		1-2				*					*	1.0 °C	20.0 °C	5.0 °C

Defrost schedule

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
t00	Defrost schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	0
t01	Def. start 1 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t11	Def. start 1 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t02	Def. start 2 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t12	Def. start 2 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t03	Def. start 3 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t13	Def. start 3 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t04	Def. start 4 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t14	Def. start 4 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t05	Def. start 5 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t15	Def. start 5 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t06	Def. start 6 - Hours		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t16	Def. start 6 - Minutes		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t07	Time hours		0-1	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t08	Time minutes		0-1	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t45	Time date		0-1	*	*	*	*	*	*	*	*	*	1	31	1
t46	Time month		0-1	*	*	*	*	*	*	*	*	*	1	12	1
t47	Time year		0-1	*	*	*	*	*	*	*	*	*	0	100	0
t51	Monday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t52	Tuesday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t53	Wednesday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t54	Thursday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t55	Friday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t56	Saturday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t57	Sunday - Follow schedule	0=No, 1=Yes	1-2	*	*	*	*	*	*	*	*	*	0	1	1
t58	Event 1 Open		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t59	Event 1 Open		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t60	Event 1 Close		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t61	Event 1 Close		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t62	Event 2 Open		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t63	Event 2 Open		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t64	Event 2 Close		1-2	*	*	*	*	*	*	*	*	*	0 h	23 h	0 h
t65	Event 2 Close		1-2	*	*	*	*	*	*	*	*	*	0 min	59 min	0 min
t66	Monday event	0=Open all day, 1=Close all day, 2=Event 1, 3=Event 2	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t67	Tuesday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t68	Wednesday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t69	Thursday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t70	Friday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t71	Saturday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0
t72	Sunday event	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	0

Miscellaneous

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
o01	Delay of outputs at power-up		1-2	*	*	*	*	*	*	*	*	*	0 s	600 s	5 s
o02	DI1 Configuration	0=None, 1=DI status, 2=Door function, 3=Door alarm, 4=Defrost start, 5=Main switch, 6=Night setback, 8=Alarm at closed, 9=Alarm at open, 10=Case cleaning, 11=Forced cooling, 15=Shutdown, 16=Light control, 20=Leak detection, 24=Comp. safety, 29=Door fan stop, 31=Comp. safety 2, 32=Temp. pulldown, 33=Operation mode	1-3(1)	*	*	*		*	*	*	*	*	0	33	0
o03	Network address		1-3(1)	*	*	*	*	*	*	*	*	*	0	240	0
o05	Access code 3		3-3	*	*	*	*	*	*	*	*	*	0	999	0
o06	Temperature sensor type	0=Pt 1000, 1=PTC 1000, 2=NTC 5k, 3=NTC 10k, 4=User-defined	1-3(1)	*	*	*	*	*	*	*	*	*	0	4	0
o16	Max. hold time		1-2	*	*	*	*	*	*	*	*	*	0 min	360 min	20 min
o17	Display air S4%		1-2	*	*	*	*	*	*	*	*	*	0 %	100 %	100 %
o37	DI2 Configuration	0=None, 1=DI status, 2=Door function, 3=Door alarm, 4=Defrost start, 5=Main switch, 6=Night setback, 8=Alarm at closed, 9=Alarm at open, 10=Case cleaning, 11=Forced cooling, 13=Coordinated defrost, 15=Shutdown, 16=Light control, 20=Leak detection, 24=Comp. safety, 29=Door fan stop, 31=Comp. safety 2, 32=Temp. pulldown, 33=Operation mode	1-3(1)	*	*	*	*	*	*	*	*	*	0	33	0
o38	Light control mode	1=Day and night, 2=Network, 3=Door switch, 4=Network (Fallback), 5=Digital input	1-2		*				*			*	1	5	1
o39	MC Light signal	0=OFF, 1=ON	1-2	*	*	*	*	*	*	*	*	*	0	1	0
o41	Rail heat ON cycle day		1-2			*				*		*	0 %	100 %	100 %
o42	Rail heat ON cycle night		1-2			*				*		*	0 %	100 %	100 %
o43	Rail heat period time		1-2			*				*		*	6 min	60 min	6 min
o46	Case cleaning mode	0=OFF, 1=Fans run, 2=Cleaning	0-1	*	*	*	*	*	*	*	*	*	0	2	0
o61	Application mode	1=Comp/def/fan/alarm, 2=Comp/def/fan/light, 3=Comp/def/fan/rail, 4=Comp/def/fan/cond, 5=Two comp/def/alarm, 6=Two comp/def/light, 7=7: Two comp/def/rail, 8=8: Two comp/def/fan, 9=9: Flexible	1-3(1)	*	*	*	*	*	*	*	*	*	1	9	1
o64	Access code 2		2-2	*	*	*	*	*	*	*	*	*	0	999	0
o85	Rail heat control mode	0=ON, 1=Day/Night timer, 2=Dewpoint ctrl.	1-2			*				*		*	0	2	0
o86	Dewpoint min. limit		1-2			*				*		*	-10.0 °C	o87	2.0 °C

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
o87	Dewpoint max. limit		1-2			*				*		*	o86	50.0 °C	12.0 °C
o88	Rail heat min. ON cycle		1-2			*				*		*	0 %	100 %	30 %
o89	Door restart inj. delay		1-2	*	*	*	*	*	*	*	*	*	0 min	240 min	30 min
o97	Display readout	1=Display air, 2=S6 Product temp., 3=Ther. air	1-2	*	*	*	*	*	*	*	*	*	1	3	1
o98	Light at Main switch OFF	0=OFF, 1=Normal ctrl.	1-2		*				*			*	0	1	0
oa1	Baudrate	1=Auto, 2=9600 Baud, 3=19200 Baud, 4=38400 Baud, 5=115200 baud	1-3[1]	*	*	*	*	*	*	*	*	*	1	5	1
oa2	Parity and stop bit	0=None, 1=Even, 2=Odd	1-3[1]	*	*	*	*	*	*	*	*	*	0	2	1

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.

Control

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
P39	Resonance band start		1-2	*	*	*	*					*	0 %	100 %	100 %
P40	Resonance band		1-2	*	*	*	*					*	0 %	15 %	0 %
P41	Alarm relay priority	0=Not used, 1=High Priority, 2=Medium priority, 3=All	1-2	*				*				*	0	3	2
P65	Fan stop at blinds closing		1-2		*							*	0 s	300 s	0 s
P77	Oil return speed limit		1-2	*	*	*	*					*	0 %	100 %	40 %
P78	Oil return interval		1-2	*	*	*	*					*	5 min	720 min	20 min
P79	Oil return speed		1-2	*	*	*	*					*	P77	100 %	50 %
P80	Oil return time period		1-2	*	*	*	*					*	10 s	600 s	60 s
P88	Access code 1		1-1	*	*	*	*	*	*	*	*	*	0	999	0
P89	Display keyboard lock	0=None, 1=Local, 2=Network	1-2	*	*	*	*	*	*	*	*	*	0	2	0
P92	Safety action	0=None, 1=Lights off	1-2		*				*			*	0	1	0
P93	Safety event period		1-2[1]	*	*	*	*	*	*	*	*	*	0 h	120 h	0 h
P94	Max safety events		1-2[1]	*	*	*	*	*	*	*	*	*	0	20	0

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.

DO config and manual

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
q01	DO1 Configuration	0=None, 1=Fans, 3=Defrost, 4=Rail heat, 5=Alarm, 6=Light, 8=Compressor/LLSV, 9=Compressor 2, 10=Air heater, 12=Condenser fan, 13=Drain heater, 14=Defrost B	1-3[1]									*	0	14	0
q02	DO2 Configuration	As above	1-3[1]									*	0	14	0
q03	DO3 Configuration	As above	1-3[1]									*	0	14	0
q04	DO4 Configuration	As above	1-3[1]									*	0	14	0
q09	AO1 Configuration	0=None, 3=Comp. speed	1-3[1]	*	*	*	*					*	0	3	0
q12	Compressor 1 - override	0=MAN OFF, 1=MAN ON	1-2[2]	*	*	*	*	*	*	*	*	*	0	1	0
q13	Fan - override	As above	1-2[2]	*	*	*	*				*	*	0	1	0
q14	Defrost A - override	As above	1-2[2]	*	*	*	*	*	*	*	*	*	0	1	0
q15	Rail heat - override	As above	1-2[2]			*				*		*	0	1	0
q16	Alarm relay - override	As above	1-2[2]	*				*				*	0	1	0
q17	Light - override	As above	1-2[2]		*				*			*	0	1	0
q19	Compressor 2 - override	As above	1-2[2]					*	*	*	*	*	0	1	0
q22	Defrost B - override	As above	1-2[2]									*	0	1	0
q23	Air heater - override	As above	1-2[2]									*	0	1	0

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
q28	High temperature - Priority	0=Disabled, 3=Low, 2=Medium, 1=High	1-2	*	*	*	*	*	*	*	*	*	0	3	1
q29	Low temperature - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	1
q30	Sensor errors - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	1
q31	DI alarms - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	2
q32	Defrost - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	3
q33	Miscellaneous - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	2
q35	Control stopped - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	3
q36	Leak detection - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	2
q39	Food temp. sensor	1=Thermostat air, 2=Alarm air, 3=S3 Air ON evap., 4=S6 Product temp.	1-2[1]	*	*	*	*	*	*	*	*	*	1	4	1
q48	Condenser fan - override	0=MAN OFF, 1=MAN ON	1-2[2]				*					*	0	1	0
q49	Compressor speed - override		1-2[2]	*	*	*	*					*	0 %	100 %	0 %
q52	Drip tray heater override	0=MAN OFF, 1=MAN ON	1-2[2]									*	0	1	0
q53	Compressor - Priority	0=Disabled, 3=Low, 2=Medium, 1=High	1-2	*	*	*	*	*	*	*	*	*	0	3	2
q54	Condenser - Priority	As above	1-2	*	*	*	*	*	*	*	*	*	0	3	2
q58	Manage operation modes	0=None, 1=Copy to mode 1, 2=Copy to mode 2, 3=Clear modes	3-3	*	*	*	*	*	*	*	*	*	0	3	0
q59	Leak alarm action	0=None, 1=Comp. OFF, 2=Comp OFF/All fans ON, 3=Shutdown	1-2	*	*	*	*	*	*	*	*	*	0	3	0
q60	AI1 Configration	0=None, 3=S3 Air ON evap., 4=S4 Air OFF evap., 5=S5 Evap. temp, 6=S6 Product, 10=S5B Evap. temp, 15=Sc Condenser	1-3[1]									*	0	15	0
q61	AI2 Configration	As above	1-3[1]									*	0	15	0
q62	AI3 Configration	As above	1-3[1]									*	0	15	0
q63	AI4 Configration	As above	1-3[1]									*	0	15	0
q80	Display filter time		1-2	*	*	*	*	*	*	*	*	*	0 s	600 s	0 s
q81	BLE Access level	0=Always access, 1=Level 1, 2=Level 2, 3=Level 3, 4=No access	1-3	*	*	*	*	*	*	*	*	*	0	4	0

[1] In order to change this parameter the regulation must be stopped via the parameter r12 Main switch = OFF.
[2] In order to change this parameter the parameter r12 Main switch must be set in position "SEr" allowing manual control of outputs.

Service

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
u00	Control state	0=Normal ctrl., 1=Hold after defrost, 2=Min ON timer, 3=Min OFF timer, 4=Drip off, 10=Main switch OFF, 11=Thermostat cut-out, 12=Frost protection S4, 14=Defrost, 15=Fan delay, 17=Door open, 18=Melt period, 19=Modulating temp. control, 20=Emergency control, 25=Manual control, 29=Case cleaning, 30=Forced cooling, 32=Power-up delay, 33=Air heating, 34=Comp. safety cut-out, 41=High Sc temp., 45=Shut down controller, 50=High S7 Brine inlet, 51=Oil recovery, 52=Temp. pulldown, 53=Comp. Lockout, 54=Leak action, 55=Wrong IO config	0-X	*	*	*	*	*	*	*	*	*	0	55	0
u09	S5 Evaporator A		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C

Code	Function	Values	R-W	1	2	3	4	5	6	7	8	9	Min.	Max.	Fact.
u10	DI1 Status	0=OFF, 1=ON	0-X	*	*	*	*	*	*	*	*	*	0	1	0
u11	Defrost time		0-X	*	*	*	*	*	*	*	*	*	0 min	900 min	0 min
u12	S3 Air ON evap.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
u13	Night condition	0=OFF, 1=ON	0-X	*	*	*	*	*	*	*	*	*	0	1	0
u16	S4 Air OFF evap.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
u17	Thermostat air temp.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
u18	Thermostat run time		0-X	*	*	*	*	*	*	*	*	*	0 min	999 min	0 min
u36	S6 product temp.		0-X									*	-200 °C	200 °C	0 °C
u37	DI2 Status	0=OFF, 1=ON	0-X	*	*	*	*	*	*	*	*	*	0	1	0
u52	Compressor speed		0-X	*	*	*	*					*	0 %	100 %	0 %
u56	Display readout		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
u57	Alarm air temp.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
u58	Compressor 1	0=OFF, 1=ON	0-X	*	*	*	*	*	*	*	*	*	0	1	0
u59	Fan	0=OFF, 1=ON	0-X	*	*	*	*				*	*	0	1	0
u60	Defrost A	0=OFF, 1=ON	0-X	*	*	*	*	*	*	*	*	*	0	1	0
u61	Rail heat	0=OFF, 1=ON	0-X			*				*		*	0	1	0
u62	Alarm relay	0=OFF, 1=ON	0-X	*				*				*	0	1	0
u63	Light	0=OFF, 1=ON	0-X		*				*			*	0	1	0
u67	Compressor 2	0=OFF, 1=ON	0-X					*	*	*	*	*	0	1	0
u75	S5 Evaporator B		0-X									*	-200 °C	200 °C	0 °C
u81	Drip tray heater	0=OFF, 1=ON	0-X									*	0	1	0
u83	Defrost B	0=OFF, 1=ON	0-X									*	0	1	0
u84	Air heater	0=OFF, 1=ON	0-X									*	0	1	0
u85	Rail heat power		0-X			*				*		*	0 %	100 %	0 %
u90	Thermostat cut-in temp.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	4.0 °C
u91	Thermostat cut-out temp.		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	2.0 °C
U09	Sc Condenser temp.		0-X				*					*	-200 °C	200 °C	0.0 °C
U16	Condenser fan	0=OFF, 1=ON	0-X				*					*	0	1	0
U45	Network status		0-X	*	*	*	*	*	*	*	*	*	0 %	100 %	0 %
U72	Food temperature		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
U73	Defrost sensor temperature A		0-X	*	*	*	*	*	*	*	*	*	-200 °C	200 °C	0 °C
U93	Defrost sensor temperature B		0-X									*	-200 °C	200 °C	0 °C
ua1	Operation mode	0=None, 1=Mode 1, 2=Mode 2	0-X	*	*	*	*	*	*	*	*	*	0	2	0
ua2	Average defrost time		0-X	*	*	*	*	*	*	*	*	*	0 min	600 min	0 min

Parameters

Connect menu

Start / Stop

Code	Function	Description	Values	Short name
r12	Main switch	Start / stop of refrigeration. With this setting refrigeration can be started, stopped or a manual override of the outputs can be allowed. (For manual control the value is set at -1). Then the outputs can be force controlled. Start / stop of refrigeration can also be accomplished with the external switch function connected to a DI input.Stopped control will give a "Main switch OFF" alarm. Be aware, Some configuration parameters requires that Main switch is set in OFF position in order to be changed.	-1=Manual, 0=Stop, 1=Start	r12 Main switch
o01	Delay of outputs at power-up	Delay of output signal after start-up After start-up or a power failure the controller's functions can be delayed so that overloading of the electricity supply network is avoided. Here you can set the time delay.		o01 DelayOfOutp.

Configuration

Code	Function	Description	Values	Short name
r12	Main switch	Start / stop of refrigeration. With this setting refrigeration can be started, stopped or a manual override of the outputs can be allowed. (For manual control the value is set at -1). Then the outputs can be force controlled. Start / stop of refrigeration can also be accomplished with the external switch function connected to a DI input.Stopped control will give a "Main switch OFF" alarm. Be aware, Some configuration parameters requires that Main switch is set in OFF position in order to be changed.	-1=Manual, 0=Stop, 1=Start	r12 Main switch
o61	Application mode	Selection of application The controller covers several applications for control of a refrigerated case. Here you set which of the possible applications is required.This menu can only be set when regulation is stopped, i.e. "r12 Main Switch" is set to 0.	1=1: Comp/def/fan/alarm, 2=2: Comp/def/fan/light, 3=3: Comp/def/fan/rail, 4=4: Comp/def/fan/cond, 5=5: Two comp/def/alarm, 6=6: Two comp/def/light, 7=7: Two comp/def/rail, 8=8: Two comp/def/fan, 9=9: Flexible	o61 Appl. mode
q01	DO1 Configuration	Select the function of the digital output It is recommended to use this output for the compressor The relay rating for this output is: DO1 SPST (1-NO) DO1 CE 10(10)A, UL 10A/10FLA/60LRA	0=None, 1=Fans, 3=Defrost, 4=Rail heat, 5=Alarm, 6=Light, 8=Compressor/LLSV, 9=Compressor 2, 10=Air heater, 12=Condenser fan, 13=Drain heater, 14=Defrost B	q01 DO1 Config.
q02	DO2 Configuration	Select the function of the digital output It is recommended to use this output for defrost heaters, hot gas valve, light/night cutains.When used for light control, the light shall be connected to the NC terminal no. 7 ensuring that light is turned on in case of power failure to the controller The relay rating for this output is: DO2 SPDT (1-C/O) DO2 CE 10(10)A, UL 10A/10FLA/60LRA	As DO1 Configuration	q02 DO2 Config.
q03	DO3 Configuration	Select the function of the digital output It is recommended to use this output for the evaporator or condenser fans at it is capable of handling high in-rush currents from ECM motors The relay rating for this output is: DO3 SPST (1-NO) DO3 CE 6(5)A, UL 6A/5FLA/30LRA	As DO1 Configuration	q03 DO3 Config.

Code	Function	Description	Values	Short name
q04	DO4 Configuration	Select the function of the digital output This output has a higher insulation degree, so that low voltage systems can be connected to this output.It is recommended to use this output for especially alarm circuit and light circuit, as the ralay have double contacts. When used for alarm/light control, the alarm/light shall be connected to the NC terminal no. 12 ensuring that alarm/light is turned on in case of power failure to the controller The relay rating for this output is: DO4 SPDT (1-C/O) DO3 CE 6(5)A, UL 6A/5FLA/30LRA	As DO1 Configuration	q04 DO4 Config.
q09	AO1 Configuration	Select the function of the analogue output	0=None, 3=Comp. speed	q09 AO1 Config.
q60	AI1 Configration	Select the function of the analogue input	0=None, 3=S3 Air ON evap., 4=S4 Air OFF evap., 5=S5 Evap. temp, 6=S6 Product, 10=S5B Evap. temp, 15=Sc Condenser	q60 AI1 Config.
q61	AI2 Configration	Select the function of the analogue input	As AI1 Configuration	q61 AI2 Config.
q62	AI3 Configration	Select the function of the analogue input	As AI1 Configuration	q62 AI3 Config.
q63	AI4 Configration	Select the function of the analogue input	As AI1 Configuration	q63 AI4 Config.
o02	DI1 Configuration	Select the function of the digital input	0=None, 1=DI status, 2=Door function, 3=Door alarm, 4=Defrost start, 5=Main switch, 6=Night setback, 8=Alarm at closed, 9=Alarm at open, 10=Case cleaning, 11=Forced cooling, 13=Coordinated defrost, 15=Shutdown, 16=Light control, 20=Leak detection, 24=Comp. safety, 29=Door fan stop, 31=Comp. safety 2, 32=Temp. pulldown, 33=Operation mode	o02 DI1 Config.
o37	DI2 Configuration	Select the function of the digital input	As DI1 Configuration	o37 DI2 Config.
o06	Temperature sensor type	Sensor type for S3, S4 and S5. Normally a Pt 1000 sensor with great signal accuracy is used. But you can also use a sensor with another signal accuracy. That could e.g. be a PTC sensor (1000 ohm at 25°C) All the mounted sensors S3-S5 must be of the same type	0=Pt 1000, 1=PTC 1000, 2=NTC 5k, 3=NTC 10k, 4=User-defined	o06 SensorConfig
X20	Sensor point 1 - Temp.	The temperature value for the user-defined temperature sensor in the reference point		--- SP1 Temp
X21	Sensor point 1 - kohm	The resistance value in kohm for the user-defined temperature sensor in the reference point		--- SP1 kohm
X22	Sensor point 1 - ohm	The resistance value in ohm for the user-defined temperature sensor in the reference point		--- SP1 ohm
X23	Sensor point 2 - Temp.	The temperature value for the user-defined temperature sensor in the reference point		--- SP2 Temp
X24	Sensor point 2 - kohm	The resistance value in kohm for the user-defined temperature sensor in the reference point		--- SP2 kohm
X25	Sensor point 2 - ohm	The resistance value in ohm for the user-defined temperature sensor in the reference point		--- SP2 ohm
X26	Sensor point 3 - Temp.	The temperature value for the user-defined temperature sensor in the reference point		--- SP3 Temp
X27	Sensor point 3 - kohm	The resistance value in kohm for the user-defined temperature sensor in the reference point		--- SP3 kohm

Code	Function	Description	Values	Short name
X28	Sensor point 3 - ohm	The resistance value in ohm for the user-defined temperature sensor in the reference point		--- SP3 ohm
c08	Step control mode	Selection of step control mode for compressors. Sequential and cyclic mode are used when both compressors are on the same refrigeration cicuit[1]. At sequential mode compressor 1 will always be the first to start and the last to stop[2]. In cyclic mode the run time between the compressor will be equalized[3]. At dual circuit, each compressor is working on their own individual refrigeration circuit and both compressors are alwaysh running at the same time and only have a step delay between them when starting	1=Sequential, 2=Cyclic, 3=Dual circuits	c08 Step mode
d01	Defrost method	Select method of defrost	0=None, 1=Electrical, 2=Hot gas, 4=Air/Offcycle, 5=Electrical pulsing	d01 Def. method
d10	Defrost stop method	Here you define whether a defrost cycle is to be stopped by time or by a temperature sensor	0=Time, 1=S5 sensor, 2=S4 sensor, 3=S5A and S5B	d10 DefStopSens.
d02	Defrost stop limit	When the selected defrost stop sensor reaches the set limit, the defrost cycle is terminated		d02 Def.StopTemp
r89	Food type	When changing the food type the controller will automatically adapt temperature setpoints and alarm limits according to the selected food type. Please be aware that the setting will revert to “None" after having been changed.	0=None, 1=Vegetables, 2=Dairy, 3=Meat and fish, 4=Frozen food, 5=Ice cream	r89 Food type
q39	Food temp. sensor	Select the temperature to be used for the food temperature representation	1=Thermostat air, 2=Alarm air, 3=S3 Air ON evap., 4=S6 Product temp.	q39 Food sensor
o03	Network address	Network address of the controller		o03 Unit addr.
U61	DO1 Function	Function on DO1		U61 DO1 Config.
U62	DO2 Function	Function on DO2		U62 DO2 Config.
U63	DO3 Function	Function on DO3		U63 DO3 Config.
U64	DO4 Function	Function on DO4		U64 DO4 Config.
Y55	DI1 Function	Function on DI1		Y55 DI1 Config
Y56	DI2 Function	Function on DI2		Y56 DI2 Config
Y58	AI1 Function	Sensor on AI1		Y58 AI1 Config
Y59	AI2 Function	Sensor on AI2		Y59 AI2 Config
Y60	AI3 Function	Sensor on AI3		Y60 AI3 Config
Y61	AI4 Function	Sensor on AI4		Y61 AI4 Config
U69	AO1 Function	Function on AO1		U69 AO1 Config.

Thermostat control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	0=Normal ctrl., 1=Hold after defrost, 2=Min ON timer, 3=Min OFF timer, 4=Drip off, 10=Main switch OFF, 11=Thermostat cut-out, 12=Frost protection S4, 14=Defrost, 15=Fan delay, 17=Door open, 18=Melt period, 19=Modulating temp. ctrl, 20=Emergency control, 25=Manual control, 29=Case cleaning, 30=Forced cooling, 32=Power-up delay, 33=Air heating, 34=Comp. safety cut-out, 41=High Sc temp., 45=Shut down controller, 51=Oil recovery, 52=Temp. pulldown, 53=Comp. Lockout, 54=Leak action, 55=Wrong IO config	u00 Ctrl. state
u17	Thermostat air temp.	Thermostat temperature		u17 Ther. air
U72	Food temperature	Readout of food temperature		U72 Food temp.
u12	S3 Air ON evap.	Actual temperature of S3 Air ON sensor placed in air flow before evaporator		u12 S3 air temp.
u16	S4 Air OFF evap.	Actual temperature of S4 Air OFF sensor placed in air flow after evaporator		u16 S4 air temp.
u36	S6 product temp.	Actual temperature of S6 Product sensor placed at a position to represent temperature of stored food		u36 S6 temp.
u13	Night condition	Status of the day/night operation (night operation: on/off)	0=OFF, 1=ON	u13 Night Cond.
X31	Air temp. performance	Average air temperature performance of the unit in the last 24 hours. A high value means that the average air temperature for the majority of time has been within the thermostat operational band		--- TQAvgTmpPerf
X30	Average air temp.	Average thermostat air temperature for the last 24 hours		--- TQAvgAirTemp
u84	Air heater	Actual status of air heater output	0=OFF, 1=ON	u84 Heat relay
ua1	Operation mode	Read-out of the current operation mode	0=None, 1=Mode 1, 2=Mode 2	Ua1 Operate Mode
u90	Thermostat cut-in temp.	Readout of the actual cut-in value for the thermostat		u90 Cutin temp.
u91	Thermostat cut-out temp.	Readout of the actual cut-out value for the thermostat		u91 Cutout temp.
u18	Thermostat run time	Read the ongoing cut-in time for the thermostat or the duration of the last completed cut-in		u18 Ther runtime
X70	Door openings 24h	Number of door openings for the last 24 hours		--- DoorOpen24h
X71	Door open time 24h	Accumulated door opening time for the last 24 hours		--- DoorTime24h
r14	Thermostat mode	Operation mode of the thermostat Either as an ordinary ON/OFF thermostat or as a modulating thermostat with variable speed compressor. The thermostat differential (r01) shall not be set lower than 2K for a variable speed compressor	1=ON/OFF 2=Modulating,	r14 Therm. mode
r00	Cut-out 1	Setpoint. The thermostat's cut-out limit		r00 Cutout
r01	Differential	When the temperature is higher than the set cut-out + the set differential, the compressor relay will be cut-in. It will cut-out again when the temperature comes down to the set cut-out limit		r01 Differential
r02	Max cut-out limit	Setpoint limitation - The controller's setting range for the thermostat setpoint may be narrowed down, so that too high or too low values are not set accidentally - with resulting damages.		r02 Max cutout

Code	Function	Description	Values	Short name
r03	Min cut-out limit	Setpoint limitation - The controller's setting range for the thermostat setpoint may be narrowed down, so that too high or too low values are not set accidentally - with resulting damages.		r03 Min cutout
r15	Thermostat sensor S4 %	Selection of thermostat sensor. Here you define the sensor that the thermostat is to use for its control function. S3, S4, or a combination of them. With the setting 0%, only S3 is used. With 100%, only S4.		r15 Ther. S4 %
r61	Thermostat sensor S4 % night	Selection of thermostat sensor S4% during night operation with night blinds. Here you define the sensor that the thermostat is to use for its control function. S3, S4, or a combination of them. With the setting 0%, only S3 is used. With 100%, only S4.		r61 Ther.S4% Ngt
r13	Night offset	Night setback value.The thermostat's reference will be the set-point plus this value when the controller changes over to night operation.		r13 Night offset
ra1	Temp. pulldown diff	Temperature differential for temperature pulldown. How many degrees shall the thermostat temperature be pulled below the normal thermostat set point		ra1 Temp PD diff
ra2	Temp. pulldown time	Duration of temperature pulldown cycle		ra2 Temp PD time
r98	S4 frost protection	Frost protection on S4 air temperature. If the S4 temperature sensor measure a temperature lower than the set limit, refrigeration will be stopped in order to protect products from ice formation. Refrigeration will start again when the S4 temperature has risen 2K above the set limit		r98 S4 Min Lim
r62	Air heater neutral zone	Heat function. Set the width of the Neutral Zone for changeover from cooling to heating		r62 Heat NZ
r63	Air heater start delay	Time delay on transition from refrigeration phase to heating phase (there is no time delay on transition from heating phase to refrigeration)		r63 HeatStartDel
r16	Melt interval	Melt function. Only for control of MT cases/rooms (-5 to +10 °C). The function ensures that the evaporator will not be blocked by ice crystals. Here you set how often the function is to stop the refrigeration and hence transform the ice crystals to water.		r16 MeltInterval
r17	Melt period	Melt period. Here you set how long an ongoing melt function is to last		r17 Melt period
X32	Temp. offset	Temperature offset value used to calculate temperature performance. Air temperature has 100% performance within the cutIn+Offset and cutOut-Offset band		--- TQTempOffset

Day/Night schedule

Code	Function	Description	Values	Short name
t58	Event 1 Day h	Start day time in hours		t58 Event1 Open
t59	Event 1 Day min	Start day time in minutes		t59 Event1 Open
t60	Event 1 Night h	Start night-time in hours		t60 Event1 Close
t61	Event 1 Night min	Start night-time in minutes		t61 Event1 Close
t62	Event 2 Day h	Start day time in hours		t62 Event2 Open
t63	Event 2 Day min	Start day time in minutes		t63 Event2 Open
t64	Event 2 Night h	Start night-time in hours		t64 Event2 Close
t65	Event 2 Night min	Start night-time in minutes		t65 Event2 Close
t66	Monday event	Select scheduled event for Mondays	0=Day, 1=Night, 2=Event 1 3=Event 2	t66 Mon Event
t67	Tuesday event	Select scheduled event for Tuesdays	As Monday	t67 Tue Event
t68	Wednesday event	Select scheduled event for Wednesdays	As Monday	t68 Wed Event
t69	Thursday event	Select scheduled event for Thursdays	As Monday	t69 Thu Event
t70	Friday event	Select scheduled event for Fridays	As Monday	t70 Fri Event
t71	Saturday event	Select scheduled event for Saturdays	As Monday	t71 Sat Event
t72	Sunday event	Select scheduled event for Sundays	As Monday	t72 Sun Event

Alarm limits and delays

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
x16	Alarm status	Actual alarm status	0=OFF, 1=ON	--- Sum alarm
u57	Alarm air temp.	Measured temperature for alarm thermostat		u57 Alarm air
y10	High alarm limit	Readout of actual high alarm limit for the temperature monitoring		--- High al. lim
y11	Low alarm limit	Readout of actual low alarm limit for the temperature monitoring		--- Low al. lim
u12	S3 Air ON evap.	Actual temperature of S3 Air ON sensor placed in air flow before evaporator		u12 S3 air temp.
u16	S4 Air OFF evap.	Actual temperature of S4 Air OFF sensor placed in air flow after evaporator		u16 S4 air temp.
u10	DI1 Status	Actual signal status of the digital input DI1	0=OFF, 1=ON	u10 DI1 status
u37	DI2 Status	Actual signal status of the digital input DI2	0=OFF, 1=ON	u37 DI2 status
x15	Reset alarms	Command for resetting all alarms, unless they are still active. Alarms can also be reset by a long press on the display alarm button while being in the alarm list	0=OFF, 1=ON	--- Reset alarm
A36	Alarm sensor S4%	Signal to the alarm thermostat Here you have to define the ratio between the sensors which the alarm thermostat has to use. S3, S4 or a combination of the two. With setting 0% only S3 is used. With 100% only S4 is used		A36 Alarm S4 %
A13	High alarm limit	Upper alarm limit. The limit value is set in absolute value. The limit value will be raised with the night offset during night operation.		A13 HighLim Air
A14	Low alarm limit	Lower alarm limit. The limit value is set in absolute value		A14 LowLim Air
A03	Alarm delay	Alarm delay (short alarm delay on air temperature). If the upper or the lower alarm limit values are exceeded, a timer function will commence. The alarm will not become active until the set time delay has been passed. The time delay is set in minutes		A03 Alarm delay
A12	Alarm delay pull down	Alarm delay at tempeature pull down conditions (long alarm delay). This time delay is used during start-up, during defrost and immediately after a defrost. There will be a change-over to the normal time delay when the temperature has dropped below the set upper alarm limit.		A12 Pulldown del
A04	Door open alarm delay	Time delay for door alarm		A04 DoorOpen del
o89	Door restart inj. delay	Start of refrigeration when the door is open. If the door has been left open, refrigeration will be started after the set time.		o89 DoorInjStart
A27	Alarm delay DI 1	Time delay for digital input alarm		A27 Al.Delay DI1
A28	Alarm delay DI 2	Time delay for digital input alarm		A28 Al.Delay DI2

Defrost control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
U73	Defrost sensor temperature A	Actual temperature of selected defrost stop sensor		U73 Def.StopTemp
U93	Defrost sensor temperature B	Actual temperature of selected defrost stop sensor S5B		U93 Def.StopTemB
u09	S5 Evaporator A	Actual temperature of S5A Evaporator sensor placed inside evaporator		u09 S5 temp.
u75	S5 Evaporator B	Actual temperature of S5B Evaporator sensor placed inside evaporator		u75 S5 temp. B
u60	Defrost A	Actual status of defrost heater A output	0=OFF, 1=ON	u60 Def. relay
u83	Defrost B	Actual status of defrost heater B output	0=OFF, 1=ON	u83 Def. relay B
u81	Drip tray heater	Actual status of drip tray heater output	0=OFF, 1=ON	u81Drip tray
u11	Defrost time	Read the duration of the ongoing defrost or the duration of the last completed defrost.		u11 Defrost time
ua2	Average defrost time	The average defrost time for the last 10 defrosts		ua2 Avr Def Time
x09	Start defrost	Command for starting a defrost	0=OFF, 1=ON	--- Def. Start

Code	Function	Description	Values	Short name
x10	Stop defrost	Command for stopping an ongoing defrost cycle	0=OFF, 1=ON	--- Def. Stop
d01	Defrost method	Select method of defrost	0=None, 1=Electrical, 2=Hot gas, 4=Air/Offcycle, 5=Electrical pulsing	d01 Def. method
d10	Defrost stop method	Here you define whether a defrost cycle is to be stopped by time or by a temperature sensor	0=Time, 1=S5 sensor, 2=S4 sensor, 3=S5A and S5B	d10 DefStopSens.
d02	Defrost stop limit	When the selected defrost stop sensor reaches the set limit, the defrost cycle is terminated		d02 Def.StopTemp
d24	Min. defrost time	Minimum duration of a defrost cycle. The defrost cycle will as a minimum run for the set minimum defrost time once it is started		d24 Min Def Time
d04	Max. defrost time	Max duration of a defrost cycle. The setting is also used as a safety time if the defrost is stopped on temperature. If the selected defrost stop sensor does not reach the set defrost stop temperature limit within the set time, the defrost will be stopped anyway.		d04 Max Def.time
d03	Defrost start interval	The function is zeroset and will start the timer function at each defrost start. When the time has expired the function will start a defrost. The function is used as a simple defrost start, or it may be used as a safeguard if the normal signal fails to appear. If master/slave defrost without clock function or without data communication is used, the interval time will be used as max. time between defrosts. If a defrost start via data communcation does not take place, the interval time will be used as max. time between defrosts.When there is defrost with clock function or data communication, the interval time must be set for a somewhat longer period of time than the planned one. In connection with power failure the interval time will be maintained, and when the power returns the interval time will continue from the maintained value. he interval time is not active when set to 0		d03 Def.Interval
d05	Time staggering power-up	Time staggering for defrost cut-ins during start-up The function is only relevant if you have several refrigeration appliances or groups where you want the defrost to be staggered in relation to one another. The function is furthermore only relevant if you have chosen defrost with interval start. The function delays the interval time by the set number of minutes, but it only does it once, and this at the very first defrost taking place when voltage is connected to the controller. The function will be active after each and every power failure.		d05 Time stagg.
d18	Max. thermostat run time	Defrost on demand. Aggregate refrigeration time set here is the refrigeration time allowed without defrosts. If the time is passed, a defrost will be started. With setting = 0 the function is not in use.		d18 MaxTherRunT.
d19	DOD S5 differential	The controller monitor the efficiency of the evaporator, and via internal calculations and measurements of the S5 temperature, it will start a defrost if the S5 temperature at thermostat cut-out has dropped with the set differential compared to when the evaporator is clean. The feature will only perform a defrost during daytime conditions. The feature is not enabled if a variable speed compressor is configured. If the value is set at 20K, the feature is disabled.		d19 CutoutS5Dif.
d16	Pump down delay	When defrost mode is selected for Hotgas, the compressor will run during the pump down delay to build up pressure and accumulate heat		d16 Pump dwn del
d42	Pressure equalization delay	Pressure equalization delay for hot gas defrost on plug-in cabinets. During pressure equalization state the hot gas valve is open in order to equalize pressure in the system.		d42 Press. Equal
d06	Drip off time	Here you set the time that is to elapse from a defrost state ends and until the compressor is to start again. (The time when water drips off the evaporator).		d06 DripOff time
d43	Hot gas valve at drip	Select whether hot gas valve shall be ON or OFF during drip state. This provides the option of having a drain heater connected to the hot gas valve output.	0=OFF, 1=ON	d43 HG ValveDrip
d20	Drip tray heater delay	The drip try heater will go ON when a defrost cycle is initiated and it will go OFF again when the set time delay has expired after the drip state		d20 DripTray del

Code	Function	Description	Values	Short name
o16	Max. hold time	Max. standby time after coordinated defrost. When a controller has completed a defrost it will wait for a signal tellingthat the refrigeration may be resumed. If this signal fails to appear for one reason or another, the controller itself will start the refrigeration when the standby time has elapsed.		o16 MaxHoldTime
d09	Fan control during defrost	Fan operation during defrost Here you can set how the fan is to operate during defrost. 0: Stopped (runs during pump down) 1: Running (stopped during "fan delay") 2: Running during pump down and defrost. After that stopped 3: Running during pump down and defrost until defrost stop sensor reaches fan stop temperature limit	0=OFF, 1=ON, 2=OFF at drip, 3=OFF at high temp	d09 FanDuringDef
d07	Fan start delay	Delay of fan start after defrost. Here you set the time that is to elapse from compressor start after a defrost and until the fan may start again. (The time when remaining water is transformed into ice on the evaporator).		d07 FanStartDel
d08	Fan start temperature	Temperature limit for starting the fans after a defrost. When the measured S5 evaporator temperature is getting below the set limit, the fans are started		d08 FanStartTemp
d41	Fan stop temperature	If the fan control during defrost has been set up for it, the fans can be stopped during the defrost if the defrost sensor exceeds the set temperature limit		d41 Def Fan Stop
d27	Rail heat during defrost	Define how rail heat is controlled during defrost0: Rail heat is OFF all the time1: Rail heat is ON all the time2: Normal rail heat control	0=OFF, 1=ON, 2=Normal control	d27 Railh.at def
d45	Cond. fan at defrost	Select whether the condenser fan shall run normal control or stop during a hot gas defrost	0=OFF, 1=Normal ctrl.	d45 Cond At Def
d40	Display delay after defrost	Set the maximum time the display should show the defrost code "-d-" after a defrost. The normal temperature readout is normally started when the temperature in the case is OK again or if a high temperature alarm is raised.		d40 Disp. d del.
d44	Temp. pulldown after defrost	Select whether a temperature pull down sequence shall be run once the defrost sequence is terminated. By running a temperature pulldown, the refrigerated goods will regain optimal storage temperature in a fast manner	0=No, 1=Yes	d44 PD After Def

Defrost schedules

Code	Function	Description	Values	Short name
t00	Defrost schedule		0=No, 1=Yes	t00 Def.Schedule
t01	Def. start 1 - Hours	Time in hours for start of defrost		t01 Def. 1 hr.
t11	Def. start 1 - Minutes	Time in minutes for when defrost cycle is to be started		t11 Def. 1 min.
t02	Def. start 2 - Hours	Time in hours for start of defrost		t02 Def. 2 hr.
t12	Def. start 2 - Minutes	Time in minutes for when defrost cycle is to be started		t12 Def. 2 min.
t03	Def. start 3 - Hours	Time in hours for start of defrost		t03 Def. 3 hr.
t13	Def. start 3 - Minutes	Time in minutes for when defrost cycle is to be started		t13 Def. 3 min.
t04	Def. start 4 - Hours	Time in hours for start of defrost		t04 Def. 4 hr.
t14	Def. start 4 - Minutes	Time in minutes for when defrost cycle is to be started		t14 Def. 4 min.
t05	Def. start 5 - Hours	Time in hours for start of defrost		t05 Def. 5 hr.
t15	Def. start 5 - Minutes	Time in minutes for when defrost cycle is to be started		t15 Def. 5 min.
t06	Def. start 6 - Hours	Time in hours for start of defrost		t06 Def. 6 hr.
t16	Def. start 6 - Minutes	Time in minutes for when defrost cycle is to be started		t16 Def. 6 min.
t51	Monday - Follow schedule	Shall schedule apply for Monday	0=No, 1=Yes	t51 Mon.Schedule
t52	Tuesday - Follow schedule	Shall schedule apply for Tuesday	0=No, 1=Yes	t52 Tue.Schedule
t53	Wednesday - Follow schedule	Shall schedule apply for Wednesday	0=No, 1=Yes	t53 Wed.Schedule
t54	Thursday - Follow schedule	Shall schedule apply for Thursday	0=No, 1=Yes	t54 Thu.Schedule

Code	Function	Description	Values	Short name
t55	Friday - Follow schedule	Shall schedule apply for Friday	0=No, 1=Yes	t55 Fri.Schedule
t56	Saturday - Follow schedule	Shall schedule apply for Saturday	0=No, 1=Yes	t56 Sat.Schedule
t57	Sunday - Follow schedule	Shall schedule apply for Sunday	0=No, 1=Yes	t57 Sun.Schedule

Compressor

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
u17	Thermostat air temp.	Thermostat temperature		u17 Ther. air
u90	Thermostat cut-in temp.	Readout of the actual cut-in value for the thermostat		u90 Cutin temp.
u91	Thermostat cut-out temp.	Readout of the actual cut-out value for the thermostat		u91 Cutout temp.
u58	Compressor 1	Actual status of compressor 1 output	0=OFF, 1=ON	u58 Comp1/LLSV
u67	Compressor 2	Actual status of compressor 2 output	0=OFF, 1=ON	u67 Comp2 relay
u52	Compressor speed	Actual compressor speed in percentage of max speed		u52 Comp. Cap.
X35	Average comp. cap.	Average compressor capacity of the unit in the last 24 hours		--- CPAvgCompCap
c01	Min ON time	Minimum time the compressor is to run once it has been started.		c01 Min. On time
c02	Min OFF time	Minimum time the compressor has to be stopped		c02 Min.Off time
c05	Delay between comp.	Time delay for couplings of two compressors. The step delay is the time that has to elapse from the first compressor starts and until the next compressor starts		c05 Step delay
c08	Step control mode	Selection of step control mode for compressors. Sequential and cyclic mode are used when both compressors are on the same refrigeration cicuit[1]. At sequential mode compressor 1 will always be the first to start and the last to stop[2]. In cyclic mode the run time between the compressor will be equalized[3]. At dual circuit, each compressor is working on their own individual refrigeration circuit and both compressors are alwaysh running at the same time and only have a step delay between them when starting	1=Sequential, 2=Cyclic, 3=Dual circuits	c08 Step mode
c97	Comp. defrost speed	The compressor will run with the defined speed during the hot gas defrost		c97 DefrostSpeed
c99	Comp cut-out delay	The time the thermostat air temperature is allowed to be below the thermostat cut-out limit before the variable speed compressor is stopped		c99 CmpCutOutDel
c49	Stop speed	Frequency signal for stopping the compressor		c49 Stop Speed
c46	Minimum speed	Frequency signal at minimum allowed compressor speed		c46 Min Speed
c47	Start speed	Frequency signal at start speed of compressor. Once started the compressor will run at this speed for 10 seconds, before the variable speed control starts		c47 Start Speed
c48	Max speed	Frequency signal at maximum allowed compressor speed		c48 Max Speed
c96	Max. speed slope	Limitation on how fast the speed can ramp up/down (set in % per. second)		c96 MaxSlopeRate
c82	Speed Kp	Amplification factor Kp for PI control of speed		c82 Speed Kp
c83	Speed Tn	Integration factor Tn for PI control of speed		c83 Speed Tn
c98	Max. Kp factor	Max. Kp value at high deviation from the temperature setpoint		c98 Speed Kp Max
P79	Oil return speed	Set the speed at which the compressor will run during an oil return cycle		P79 OilRtrnSpeed
P80	Oil return time period	Set the time period for which the compressor will run at increased speed during an oil return cycle		P80 OilRtPeriod
P77	Oil return speed limit	If the compressor is running below the set speed limit, an oil return counter is increased. When the counter reaches the defined "Oil return cycle time", an oil return cycle will be initiated		P77 OilRtSpdLim
P78	Oil return interval	When the counter for low speed operation reaches this value, an oil return cycle is initiated		P78 OilRtIntrval
P39	Resonance band start	Variable speed level at which the resonance band starts		P39 Reson. start

Code	Function	Description	Values	Short name
P40	Resonance band	Width of the resonance band		P40 Reson. band
P94	Max safety events	The maximum number of repeated compressor safety or condenser block safety events before the compressors are locked out and a manual alarm reset is required to restart compressor operation. Setting the value at 0 will disable compressor lock out feature.		P94 SafetyEvents
P93	Safety event period	Time period for counting maximum number of allowed safety events for compressor safety and condenser block safety. Setting the value at 0 will disable compressor lock out feature.		P93 SafetyPeriod
P92	Safety action	Select the action taken if repeated condenser block alarms result in lockout of compressors	0=None, 1=Lights off	P92 SafetyAction

Condenser control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
U09	Sc Condenser temp.	Actual temperature of the Sc Codenser sensor placed on the air cooled condenser		U09 Sc2 temp.
U16	Condenser fan	Actual status of the condenser fan output	0=OFF, 1=ON	U16 Cond. fan
F24	Cond. fan cut-in	Temperature setting at which the condenser fan is started		F24 Cond. Cutin
F25	Cond. fan diff.	Temperature differential for stopping condenser fan		F25 Cond. diff.
A37	Cond. alarm limit	Setpoint for the condenser temperature alarm, the warning level resulting in reduction in compressor capacity (if possible). The alarm will clear when the condenser temperature is decreased with the set alarm differential		A37 CondAlarmLim
A78	Cond. alarm differential	Difference band below the condenser alarm limit and condenser block limit for clearing the alarms		A78 Cond Al Diff
A54	Cond. block limit	Setpoint for the condenser block alarm. Compressor will be stopped when the alarm delay has expired. The alarm will clear when the condenser temperature is decreased with 2 times the set alarm differential.		A54 CondBlockLim
A55	Cond. alarm delay	Delay for the condenser block alarm and potential alarm action. The delay starts when the condenser temperature exceeds the condenser block limit		A55 CondAlarmDel

Fan control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
u59	Fan	Actual status of evaporator fan output	0=OFF, 1=ON	u59 Fan relay
F05	Fan pulsing mode	Pulse operation of fan	0=No pulsing, 1=Pulsing cut-out, 2=Pulsing cut-out night	F05 FanPulseMode
F06	Fan period time	Period time for pulsing of fan		F06 Fan cycle
F07	Fan ON cycle	ON time for fan. The ON period is set as a percentage of the fan period time		F07 Fan ON %
F04	Fan stop high S5 temp.	Fan stop temperature The function stops the fans in an error situation, so that they will not provide power to the appliance. If the defrost sensor registers a higher temperature than the one set here, the fans will be stopped. There will be re-start at 2 K below the setting. The function is not active during a defrost or start-up after a defrost. With a value of 50 °C this function is disabled.		F04 FanStop temp
P65	Fan stop at blinds closing	When a light output is configured, this output might also be used to control night blinds. When light is turned OFF, the night blinds are run down and the delay gives the option to stop the fans while the night blinds are rolled down. If a delay is defined, the fans are stopped in the defined time delay in order to ensure that the blinds are closed correctly		P65 BlindFanStop

Railheat control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
x18	Dewpoint	Actual dewpoint received from system manager via network		--- Dew point
u61	Rail heat	Actual status of rail heat output	0=OFF, 1=ON	u61 Railh. relay
u85	Rail heat power	Readout of the actual rail power in %		u85 Rail DutyC %
o85	Rail heat control mode	The rail heat can be controlled in several ways: 0: Rail heat is running all the time 1: Pulse control is used with a timer function following the day/night operation 2: Pulse control is used with a dewpoint function. This function requires that a signal is received about the dewpoint value. The value is measured by a system manager and sent to the controller via the data communication.	0=ON, 1=Day/Night timer, 2=Dewpoint ctrl.	o85 Railh. mode
o41	Rail heat ON cycle day	Rail heat power during day time. The ON period is set as a percentage of the period		o41 Railh.ONday%
o42	Rail heat ON cycle night	Rail heat power during night time. The ON period is set as a percentage of the period time		o42 Railh.ONngt%
o43	Rail heat period time	Period time for pulsing of rail heat		o43 Railh.cycle
o88	Rail heat min. ON cycle	Lowest permitted rail heat power. When the measured dewpoint is below the defined minimum limit the rail heat will run with the set minimum power		o88 Rail Min ON%
o86	Dewpoint min. limit	If the measuered dewpoint is below the set value the rail heat is running at minimum heat		o86 DewP Min lim
o87	Dewpoint max. limit	If the measured dewpoint is above the set value the rail heat is maximum		o87 DewP Max lim

Light/Cleaning/Leak

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
u13	Night condition	Status of the day/night operation (night operation: on/off)	0=OFF, 1=ON	u13 Night Cond.
u63	Light	Actual status of light output	0=OFF, 1=ON	u63 Light relay
o38	Light control mode	Configuration of light function 1: Light is controlled via day/night status 2: Light is controlled via data communication and master control parameter "MC Light signal" 3: Light is controlled by door contact on DI input. When the door is opened the relay will cut in. When the door is closed again there will be a time delay of two minutes before the light is switched off. 4: As "2" but if there are any 15-minute network errors, the light will switch on and the night blind will open. 5: Light is controlled via DI input signal	1=Day and night, 2=Network, 3=Door switch, 4=Network (Fallback), 5=Digital input	o38 Light config
o98	Light at Main switch OFF	Define how light and blinds are to be controlled at Main switch OFF 0: Light is switched off and night blinds are open when the main switch is off 1: Light and night blinds are independent of main switch.	0=OFF, 1=Normal ctrl.	o98 Light MS=Off
o46	Case cleaning mode	The status of the function can be seen here or the function can be started manually.0 = Normal operation (no cleaning) 1 = Only fans are running to defrost the evaporator. All other outputs are Off. 2 = Cleaning with stopped fans. All outputs are Off. If the function is controlled by a digital input signal, the relevant status can be seen here in the menu.	0=OFF, 1=Fans run, 2=Cleaning	o46 Case clean
q59	Leak alarm action	Select the alarm action at refrigerant leak detection	0=None, 1=Comp. OFF, 2=Comp OFF/All fans ON, 3=Shutdown	q59 Leak Action

Display control

Code	Function	Description	Values	Short name
u00	Control state	Readout of the actual control state of the controller	See earlier	u00 Ctrl. state
u56	Display readout	Readout of the temperature shown on the display		u56 Display air
o97	Display readout	Select which temperature to show in the display	1=Display air, 2=S6 Product temp., 3=Ther. air	o97 Displ. Ctrl.
o17	Display air S4%	Signal to the display sensor. Here you have to define the ratio between the sensors which the display has to use. S3, S4 or a combination of the two. With setting 0% only S3 is used. With 100% only S4 is used		o17 Disp. S4 %
r04	Display readout adjustment	Correction of the display´s temperature.If the temperature at the products and the temperature received by the controller are not identical, an offset adjustment of the display temperature can be carried out.		r04 Disp. Adj. K
q80	Display filter time	To prevent too fast changes in the display readout, a filter time can be set. The parameter sets the filter time constant τ (tau) of the moving average filter for the display readout, when the displayed temperature is moving away from the thermostat set point. The filter time represents the time it takes for the display readout to reach 66% of its final value. At five time the filter time, the readout will have reached 99% of its final value. When the displayed temperature is approaching the thermostat set point, no filter is applied.		q80 Disp. Filter
r05	Temperature unit	Select whether temperatures are to be shown as °C or as °F.	0=Celsius, 1=Fahrenheit	r05 Temp.unit
P89	Display keyboard lock	With this setting it is possible to lock the keyboard operation of the local display. None: Display keyboard operation will never be lockedLocal: When not used for some time, the local display will lock the keyboard operations and a special key combination is required in order to enable the keyboard operationsNetwork: When the controller receives a master control signal (--- Key/BT lock) via the network, the display keyboard operations will be locked. The keyboard operations can only be activated again by setting the master control signal OFF via the System Manager	0=None, 1=Local, 2=Network	P89 LockDispKey
q81	BLE Access level	Here you can define the required access level for initiation of Bluetooth button	0=Always access, 1=Level 1, 2=Level 2, 3=Level 3, 4=No access	q81 BLE Access

Alarm relay priority

Code	Function	Description	Values	Short name
u62	Alarm relay	Actual status of alarm output	0=OFF, 1=ON	u62 Alarm relay
P41	Alarm relay priority	Set which alarm priorities that are to activate the alarm relay	0=Not used, 1=High Priority, 2=Medium priority, 3=All	P41 Al.Rel.Prio
q38	Mute alarm	When muting alarms, the alarm relay will stop signaling the alarm until a new alarm arises.When entering the alarm list in the AK-CC Connect APP or the display, the alarm relay will be muted	0=OFF, 1=ON	q38 Mute Alarm
q28	High temperature - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	0=Disabled, 3=Low, 2=Medium, 1=High	q28 Hi Temp Prio
q29	Low temperature - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q29 Lo Temp Prio
q30	Sensor errors - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q30 Sensor Prio
q31	DI alarms - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q31 DIAlarm Prio

Code	Function	Description	Values	Short name
q32	Defrost - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q32 Defrost Prio
q33	Miscellaneous - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q33 Misc Prio
q35	Control stopped - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q35 CtrlOFF Prio
q36	Leak detection - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q36 Leak Prio
q53	Compressor - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q53 Comp. Prio
q54	Condenser - Priority	Select the priority of the alarms assigned to the alarm group. Be aware - by selecting "Disable", the alarms will not be shown on the display or be routed to the alarm relay or to the network.	As above	q54 Cond. Prio

Miscellaneous

Miscellaneous → Network

Code	Function	Description	Values	Short name
U45	Network status	Quality of the network communication		U45 Comm. status
o03	Network address	Network address of the controller		o03 Unit addr.
oa1	Baudrate	Communication speed of network	1=Auto, 2=9600 Baud, 3=19200 Baud, 4=38400 Baud, 5=115200 baud	oa1 Bus baudrate
oa2	Parity and stop bit	Select parity and stop bit of Modbus messages	0=None, 1=Even, 2=Odd	oa2 Parity bit

Miscellaneous → Time

Code	Function	Description	Values	Short name
t07	Time hours	Hour setting for clock		t07 Clock Hour
t08	Time minutes	Minutes setting for clock		t08 Clock Minute
t45	Time date	Date setting for clock		t45 Clock Date
t46	Time month	Month setting for clock		t46 Clock Month
t47	Time year	Year setting for clock		t47 Clock Year

Miscellaneous → Access codes

Code	Function	Description	Values	Short name
o05	Access code 3	Access code for commissioning / OEM		o05 Acc. code 3
o64	Access code 2	Access code for service		o64 Acc. code 2
P88	Access code 1	Access code for daily operations		P88 Acc. code 1

Miscellaneous → Sensor adjustment

Code	Function	Description	Values	Short name
r10	S3 Air ON evap. - Adjustment	Correction of sensor signal e.g. due to long sensor cable		r10 Adjust S3
r09	S4 Air OFF evap. - Adjustment	Correction of sensor signal e.g. due to long sensor cable		r09 Adjust S4
r11	S5 Evaporator A - Adjustment	Correction of sensor signal e.g. due to long sensor cable		r11 Adjust S5
r59	S6 product temp. - Adjustment	Correction of sensor signal e.g. due to long sensor cable		r59 Adjust S6

Miscellaneous → Operation mode

Code	Function	Description	Values	Short name
q58	Manage operation modes	Manage operation mode parameter sets: Current parameter set can be copied to operation mode 1 or 2 and operation mode can be disabled by clearing the parameter set in operation mode 2. When performing a factory reset, the parameters stored in operation mode 1 will be loaded as actual used parameter set.	0=None, 1=Copy to mode 1, 2=Copy to mode 2, 3=Clear modes	q58 MakeOPMode
ua1	Operation mode	Read-out of the current operation mode	0=None, 1=Mode 1, 2=Mode 2	Ua1 Operate Mode

Advanced

Advanced → Master Control

Code	Function	Description	Values	Short name
x62	Regulation condition	Readout of the actual control state of the controller	0=Main switch OFF, 1=Injection start, 2=Superheat ctrl., 3=Fill evap., 4=Defrost, 5=Post defrost, 6=Forced closing, 7=Injection fault, 8=Emergency control, 9=Modulating ctrl., 10=Melt period, 11=Door open, 12=Case cleaning, 13=Cutout, 14=Forced cooling, 15=Shut down	--- Reg. Cond.
x63	MC Actual cut-in temp.	Readout of the actual cut-in value for the thermostat		--- Cutin temp.
x64	MC Actual cut-out temp.	Readout of the actual cut-out value for the thermostat		--- Cutout temp.
x81	MC Ther. toggle	Master control signal used for switching case load ON/OFF depending on the load condition	0=No action, 1=Toggle ON, 2=Toggle OFF	--- TherToggle
x06	MC Night setback	Master control signal for changing between day and night time operation	0=OFF, 1=ON	--- Night setbck
x17	MC Case shutdown	Master control signal used to shut down a case for a time period. During shutdown there will be no alarm monitoring	0=OFF, 1=ON	--- Case shutdwn
x08	MC Forced cooling	Master control signal that will provide forced cooling	0=OFF, 1=ON	--- Forced cool.
x13	MC Defrost start	Master control signal for starting a defrost. At adaptive defrost the defrost might be skipped if the defrost is not needed	0=OFF, 1=ON	--- MC def.start
x14	MC Defrost state	Read out the actual state of the defrost	0=OFF, 1=ON	--- DefrostState
x11	MC Hold after defrost	Master control signal used for co-ordinated defrost control to hold cabinets from returning to normal refrigeration after a defrost until all cabinets have terminated defrost	0=OFF, 1=ON	--- HoldAfterDef
x12	MC Stop defrost	Master control signal used to prevent a defrost start in a controller.	0=OFF, 1=ON	--- Disable def.
o39	MC Light signal	Master control signal for control of light via a data communication signal from the system manager	0=OFF, 1=ON	o39 Light remote
x03	MC Actual dewpoint	Master control signal sending the actual measured dewpoint from the system manager to the controller over the network.		--- Act.DewPoint
x83	MC Po load factor	Master control signal calculating the actual load of the unit		--- Load factor
aaa	MC Key/Bluetooth lock	Master control signal that will lock down all Bluetooth data communication and optionally also the operation of the display keys (depend upon selection in P89 Display keyboard lock)	0=OFF, 1=ON	--- Key/BT Lock
x82	MC Load request	Master control signal used to control the load balance between multiple case controllers on the same suction line		--- LoadReq

Alarms and fault message

In an error situation, the alarm LED on the display will be on and the alarm relay will be activated (depending on priority). By touching the alarm button, you can see the list of active alarms, please refer to the list of alarms below.

Code	Function	Description	Short name
E01	Hardware failure	The controller has a hardware failure	--- Contr. error
E06	Clock lost time	Clock has lost valid time	--- RTC error
E25	S3 Air ON evap. A - sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- S3 error
E26	S4 Air OFF evap. A - sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- S4 error
E27	S5 Evaporator A - sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- S5 error
E28	S6 product temp. A - sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- S6 error
E37	S5 Evaporator B - sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- S5 error B
E64	Sc condenser sensor error	Sensor signal is out of range. Please check the sensor for correct operation	--- Sc error
A01	High temperature alarm A	The alarm temperature has been above the max alarm limit for a longer time period than the set alarm delay.	--- High t.alarm
A02	Low temperature alarm A	The alarm temperature has been below the min alarm limit for a longer time period than the set alarm delay.	--- Low t. alarm
A04	Door open alarm	The door has been open for a too long time	--- Door alarm
A05	Max defrost hold time exceeded	The controller has been waiting longer time than permitted after a coordinated defrost.	--- Max HoldTime
A15	DI alarm 1	Alarm signal from digital input signal	--- DI1 alarm
A16	DI alarm 2	Alarm signal from digital input signal	--- DI2 alarm
A19	Comp. safety	Alarm from digital input monitoring the safety chain of compressor 1	--- Comp. fault
A45	Main switch set OFF	The controller main switch has been set to either Stop or Manual control. Alternatively, a digital input set up for "main switch" function, has stopped control	--- Standby mode
A59	Case in cleaning mode	A case cleaning operation has been started on a case	--- Case clean
A61	Cond. high temperature	The condenser temperature has reached the alarm limit. Check that the air inlet of the condenser is clean, that the air flow is not blocked and that the condenser fan is running	--- Cond Alarm
A80	Cond. block alarm	The condenser temperature has reached the block limit and has stopped the compressor. Check that the air inlet of the condenser is clean, that the air flow is not blocked and that the condenser fan is running. If this alarm arises again, better call a service company.	--- Cond Blocked
AA3	Refrigerant leak detected	Refrigerant is leaking from the refrigeration system	--- Refg.Leak
a04	Wrong IO configuration	Inputs and outputs have not been configured correctly (See appendix A for more information)	--- Wrong IO cfg
Z01	Max defrost time exceeded A	The last defrost cycle has stopped on time instead of set temperature	--- Max Def.Time
a12	Comp. safety 2	Alarm from digital input monitoring the safety chain of compressor 2	--- Comp.2 fault
a13	Compressor safety lockout[1]	The compressors/condenser have violated safety limits more times than allowed within the defined safety period and the clearance of the alarm will require a manual reset of the alarm, which can be done in one of the following ways: 1. Navigate to alarm list on display and press the alarm button for 3 seconds. 2. Power down the controller. 3. Set Main switch OFF and back ON again.	--- Comp LockOut

[1] Alarm requires manual reset via one of the following options:
1. Power off controller
2. Long press on display alarm button while in alarm menu
3. Set the parameter "r12 Main switch" OFF and ON again

Alarm routing

If an alarm relay is defined, the priority of the alarms that are send to the alarm relay can be defined, please refer to the table below.

Parameter	Value	Description
P41Alarm relay priority	0: None (no alarms are routed to relay) 1: High priority 2: High and medium priority 3: All alarms (except disabled alarms)	Select the alarm priorities that are sent to the alarm relay

The alarms are grouped, and the priorities of each alarm group can be set in accordance with the table below:

Alarm group	Priority	Code	Alarm
High Temp.	q28 High temperature - priority	A01	High temperature alarm A
Low temp.	q29 Low temperature - priority	A02	Low temperature alarm A
Sensor error	q30 Sensor errors - priority	E25	S3 Air ON evap. A - sensor error
		E26	S4 Air OFF evap. A - sensor error
		E27	S5 Evaporator A - sensor error
		E28	S6 product temp. A - sensor error
		E37	S5 Evaporator B - sensor error
		E64	Sc condenser sensor error
DI alarms	q31 DI alarms - priority	A04	Door open alarm
		A15	DI alarm 1
		A16	DI alarm 2
		AA3	Refrigerant leak detected
Defrost	q32 Defrost - priority	A05	Max defrost hold time exceeded
			Max defrost time exceeded A
Miscellaneous	q33 Miscellaneous - priority	E01	Hardware failure
		E06	Clock lost time
		a04	Wrong IO configuration
Stop of control	q35 Control stopped - priority	A45	Main switch set OFF
		A59	Case in cleaning mode
Condenser	q54 Condenser - priority	A61	Cond. high temperature
		A80	Cond. block alarm
Compressor	q53 Compressor - priority	A19	Comp. safety 1
		a12	Comp. safety 2
		a13	Comp. safety lockout

Operating status

The control state shows what the controller is doing and this value can be readout as the first parameter in the display "Info" menu.

Value	Comments
0	Not used
1	Wait for defrost master or slave
2	Wait for compressor ON time to elapse
3	Wait for compressor OFF time to elapse - Restart time
4	Defrost sequence: Drip off delay state
10	Cooling stopped by MainSwitch = Off.
11	Cooling stopped by thermostat
12	Cooling stopped by low S4 temperature
14	Defrost sequence: Defrosting state
15	Defrost sequence: Fan delay state
17	Door open (Open DI-input)
18	Melt cut-out
19	Modulating temperature control (Variable speed compressor)
20	Emergency cooling at sensor fault
25	Manual control of outputs
29	Case Cleaning
30	Forced cooling
32	Delay of outputs at power up.
33	Heating active
34	Compressor safety (DI input function)
41	High condensing temp. Sc
45	Case shut down
51	Oil recovery
52	Temperature pulldown
53	Compressor lockout on safety
54	Compressor/Unit stopped due to leak alarm
55	Wrong IO Config

Parameter	Value	Description
u00 Control state	See list above	Readout of the actual control state

Appendix

Appendix A

Handling of illegal IO configuration
At the following illegal IO combinations, the controller will raise a "Wrong IO config" alarm and control will not be able to start:

1. If no air temperature sensors have been configured (Either S3 or S4 must be configured)
2. If the same analogue input function is selected for several analogue hardware inputs
3. If no compressor has been configured
4. If compressor 2 has been configured without having configured a compressor 1
5. If two compressors have been configured, and the analogue output has been configured for compressor speed
6. If defrost B output has been configured without having configured a defrost A output
7. If evap. sensor S5B has been configured without having configured an evap. sensor S5A
8. If a condenser fan relay has been configured without having configured a condenser sensor Sc

If the controller application requests a specific sensor to be present and the sensor has not been configured, an "Wrong IO config" alarm and a sensor error alarm for the missing sensor will be raised:

1. If the application setup request S3 and S4 sensors, but only one of them has been configured
2. If the application setup requests a specific defrost sensor that has not been configured
3. If the application setup requests a S4 sensor for frost protection and it has not been configured
4. If the application setup requests a S5 sensor for fan delay and the sensor has not been configured
5. If the application setup requests a S3 or S6 sensor for food temp./display readout and the sensor has not been configured.

Appendix B

Sensor alarms
The controller will only raise a sensor alarm if the parameter setup requires a specific sensor and this sensor is not configured or is defective.
The table below shows when a specific sensor is requested:

Parameter	Setting	S3	S4	S5A	S5B	S6	Sc
r15 Ther. S4 %	= 0%	x					
	= 100%		x				
	0% < setting <100%	x	x				
r61 Ther.S4% Ngt	= 0%	x					
	= 100%		x				
	0% < setting <100%	x	x				
A36 Alarm S4 %	= 0%	x					
	= 100%		x				
	0% < setting <100%	x	x				
r98 S4 Min Lim	> -60 °C		x				
o97 Displ. Ctrl.	= 1: Display air						
o17 Disp. S4 %	= 0%	x					
	= 100%		x				
	0% < setting <100%	x	x				
d10 DefStopSens.	= 1: S5A			x			
	= 2: S4		x				
	= 3: S5A + S5B			x	x		
d19 CutoutS5Dif.	< 20 °C			x			
F04 FanStop temp	< 50 °C			x			
q39 Food sensor	= 4: S6 Product temp.					x	
o97 Displ. Ctrl.	= 2: S6 Product temp.					x	
DO1 – DO4 Config	= 12: Condenser fan						x

Ordering

Type	Packaging format	Quantity	Code no.
AK-CC25 Pro	Single pack	1	084B4022
AK-CC25 Pro	Industrial pack	27	084B4122
AK-CC25 Pro BT	Single pack	1	084B4023
AK-CC25 Pro BT	Industrial pack	27	084B4123
Connectors kit for AK-CC25 Pro	Industrial pack	81	084B4714
Interface cable AK-CC25 - KoolKey 2.1	Single pack	1	080N0334
KoolKey 2.1 (PV04)	Single pack	1	080N0020

Certificates, declarations, and approvals

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

Some approvals may change over time. You can check the most current status at danfoss.com or contact your local Danfoss representative if you have any questions.

Controller	Certification	Mark	Country
AK-CC25 Pro BT	EMC/LVD/RoHS	CE	EU
AK-CC25 Pro BT	UL recognized	cURus	NAM (US and Canada)
AK-CC25 Pro BT	RED	CE	EU
AK-CC25 Pro BT	FCC	FCC ID	USA

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